Regional Information Report No. 4K11-08

Special Project Plan: 2011 Bottom Trawl Survey of Crab and Groundfish: Kodiak, Chignik, South Peninsula, and Eastern Aleutian Districts

by

Kally Spalinger

July 2011

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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The Regional Information Report Series was established in 1987 and was redefined in 2006 to meet the Division of Commercial Fisheries regional need for publishing and archiving information such as project operational plans, area management plans, budgetary information, staff comments and opinions to Board of Fisheries proposals, interim or preliminary data and grant agency reports, special meeting or minor workshop results and other regional information not generally reported elsewhere. Reports in this series may contain raw data and preliminary results. Reports in this series receive varying degrees of regional, biometric, and editorial review; information in this series may be subsequently finalized and published in a different department reporting series or in the formal literature. Please contact the author or the Division of Commercial Fisheries if in doubt of the level of review or preliminary nature of the data reported. Regional Information Reports are available through the Alaska State Library and on the Internet at: http://www.adfg.alaska.gov/sf/publications/.

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ABSTRACT

This report specifies the objectives and methods for special projects during the 2011 Alaska Department of Fish and Game (ADF&G) bottom trawl survey of crab and groundfish in the Kodiak, Chignik, South Peninsula, and Eastern Aleutian districts of the Westward Region. This Special Project Plan is used in conjunction with the Standard Project Operational Plan (Spalinger and Cavin 2004), which describes the annual trawl survey sampling protocols. Special crab projects for 2011 include: multiple trawl tows within selected offshore survey stations in the Kodiak District to assist in determining the variance of Tanner crab *Chionoecetes bairdi* population estimates; Tanner crab hemolymph collection for genetic analysis to determine bitter crab disease prevalence; collection of adult female Tanner crab for a study on reproductive potential; measurement of chela height for male Tanner crab maturity analysis; collection of genetic material from Tanner crab for a population genetics study; and collection of red king crab *Paralithodes camtschaticus* parasitized by rhizocephalan barnacles. Special groundfish projects for 2011 include: collection of stomachs from walleye pollock *Theragra chalcogramma*, Pacific cod *Gadus macrocephalus*, flathead sole *Hippoglossoides elassodon*, arrowtooth flounder *Atheresthes stomias*, Pacific halibut *Hippoglossus stenolepis*, northern rock sole *Lepidopsetta polyxystra*, and spiny dogfish *Squalus acanthias* for a National Marine Fisheries Service (NMFS) food habits study; and collection of age-0 and age-1 walleye pollock, sablefish *Anoplopoma fimbria*, Pacific cod, arrowtooth flounder, and rockfish *Sebastes* spp. for a NMFS recruitment study. Additionally, specimen collection and pictures of various species will be taken for to the skeletal reference collection at the University of Victoria and for ADF&G field guides.

Key words: Tanner crab, shellfish, groundfish, trawl survey, Kodiak, Alaska Peninsula, Chignik, Eastern Aleutian Islands, special projects

INTRODUCTION

From June through September 2011, the Alaska Department of Fish and Game (ADF&G) will conduct a bottom-trawl survey in portions of the Westward Region (Figure 1). The survey will focus on waters of historic red king *Paralithodes camtschaticus* and Tanner crab *Chionoecetes bairdi* abundance around Kodiak Island and the Alaska Peninsula from Cape Douglas to False Pass, as well as the Eastern Aleutian Islands. Survey results will be used to estimate the abundance of Tanner crab and red king crab populations and to determine species composition and length frequencies of groundfish catch by haul and area.

This report details the survey schedule, station maps, and sampling procedures for special projects during the 2011 Westward Region trawl survey. All standard sampling protocols used during the trawl survey are described in detail in the Standard Project Operational Plan (Spalinger and Cavin 2004). Any changes to standard procedures, or special projects associated with the 2011 survey are described in this document.

OBJECTIVES

Special shellfish objectives for the 2011 trawl survey are to collect and freeze adult female Tanner crab from the Northeast, Eastside, and Westside sections of the Kodiak District for determination of fecundity, spermathecal load, and overall reproductive health. Measurement of chela height from male Tanner crab in the Northeast Section will be expanded to include Eastside and Westside sections of the Kodiak District. In addition to the standard collection of hemolymph smears in Alitak Bay (Spalinger and Cavin 2004), additional hemolymph samples will be collected, preserved, and used to look for the presence of genetic markers consistent with the parasitic dinoflagellate causing bitter crab disease. Tanner crab tissue will be collected as part of a population genetics study conducted by the University of Alaska. Finally, red king crab encountered that are visibly parasitized by a rhizocephalan barnacle will be collected for a phylogenetic study.

Special groundfish objectives are to collect whole stomachs and stomach contents from walleye pollock *Theragra chalcogramma*, Pacific cod *Gadus macrocephalus*, flathead sole *Hippoglossoides elassodon*, arrowtooth flounder *Atheresthes stomias*, Pacific halibut *Hippoglossus stenolepis*, northern rock sole *Lepidopsetta polyxystra*, and spiny dogfish *Squalus acanthias* from Marmot and Chiniak bays and to collect age-0 and age-1 walleye pollock, sablefish *Anoplopoma fimbria*, Pacific cod, arrowtooth flounder, and rockfish *Sebastes* and *Sebastolobus* from around Kodiak Island, Shelikof Strait, and the Shumagin Islands. We will continue to speciate blackspotted rockfish *Sebastes melanostichus* from rougheye rockfish *S. aleutianus*. Blackspotted and rougheye rockfish were previously considered a single species but are now recognized as two separate species (Orr and Hawkins 2008). The sex of each measured shark and skate *Raja* and *Bathyraja* will be recorded. Multiple trawl tows for selected survey stations in Marmot Bay and the Barnabas Gully of the Kodiak District will occur to determine the accuracy of Tanner crab station population estimates.

METHODS

SURVEY AREA AND TRAWL PROCEDURES

The 27.4 m ADF&G research vessel *Resolution* will conduct survey trawl tows using a 400-mesh eastern otter trawl in areas of known king crab and Tanner crab habitat in the Kodiak, Chignik, and South Peninsula districts of the Westward Region (Figure 1, Appendices A1–A12). Akutan, Unalaska, Makushin, and Pumicestone bays in the Eastern Aleutian District will be included in the 2011 survey (Appendices A13 and A14).

Duplicate trawl tows will occur in pre-selected large offshore stations in the Northeast and Eastside sections of the Kodiak District. Stations were selected based on large Tanner crab population estimates from previous surveys (Spalinger *in prep*, Spalinger 2010, Spalinger 2009, Spalinger 2008). Four stations in Marmot Bay (Appendix A2) and four stations in Barnabas Gully (Appendix A3) are divided into four quadrants. In addition to the traditional tow which will be sampled according to the Standard Project Operational Plan (Spalinger and Cavin 2004), two to three additional trawl tows, depending on time and weather, will be made in different quadrants of the selected stations. Stations with additional tows will be surveyed in the following order of priority: Marmot Bay: 255, MONX, 256, and 283X (Appendix A2); Barnabas Gully: 561, 655, 696, and 559 (Appendix A3). Total catch from the extra tows will be weighed, but only Tanner crab will be sorted and weighed. Crab will be sampled according to the Standard Project Operational Plan (Spalinger and Cavin 2004).

CRAB SAMPLING

Adult female Tanner crab will be collected from defined sampling areas in the Northeast, Eastside, and Westside sections of the Kodiak District (Appendices B1 and B2). Samples will be held on deck until the end of the day, or when tows in the sampling area are completed. Samples should represent all tows in the area if possible, rather than one tow only. For each size group and bay, 15 primiparous and 15 multiparous female Tanner crab will be collected (Appendix B3). Each crab should be classified by shell condition and placed in an individual bag with a label indicating the size category, shell condition, and sampling area of collection. Crab should be kept separate to ensure legs are kept with their respective carapace as legs often fall off during freezing and transport. All bags containing crab from the same size group, sampling area, and maturity (primiparous or multiparous; Appendix B3) can be placed into one larger bag labeled

with sampling information, and placed in boxes to prevent crushing in the freezer. Upon arrival in the laboratory, crab will be examined for fecundity, spermathecal load, and overall reproductive health.

Chela height measurements of male Tanner crab will be collected from the Northeast, Eastside and Westside sections of the Kodiak District (Appendices A3 and A8). Protocol for chela height measurement will follow the standard procedures in Spalinger and Cavin (2004), with one exception; measurements will be collected randomly from 50 male Tanner crab >50 mm in carapace width (CW) at each station. The cruise leader may adjust the sampling plan as needed to accommodate high numbers of crab encountered on the Eastside survey. In this situation the cruise leader may choose to measure chela from every third station, or modify the plan in other ways to allow for timely return of captured crab to the water. Cruise leaders will detail exact sampling procedures to be kept with data from each haul so methods are repeatable and data analysis can be conducted accordingly. Chela height to carapace width ratio will determine size at morphometric maturity of male Tanner crab and will be compared among areas and years.

Samples of hemolymph from Tanner crab in Alitak Bay (Appendix A5) will be preserved in ethanol for genetic testing to identify parasite DNA (Jensen et al. 2010; Appendix C1). Samples for this test will be collected in conjunction with the standard hemolymph smears as described in the Standard Project Operational Plan (Spalinger and Cavin 2004). Information should be recorded on an ADF&G Bitter Crab Sample Data Form (Appendix D1). After collection, preserved samples will be stored in a dark location at room temperature until arrangements are made to ship to a genetics laboratory for testing. Results from genetic testing will be compared to results from hemolymph smears to determine smear accuracy, and the feasibility of replacing hemolymph smears with genetic testing.

Tissue from up to 40 male and 40 female Tanner crab will be collected from 4 distinct locations during the survey (Appendices E1 and E2) for a statewide population genetics study conducted by the University of Alaska. The distal dactyl of a leg will be pulled from each crab and stored in a vial of ethanol. Each vial should contain a label with a unique specimen number referencing information about the crab such as haul number, sex, carapace width, shell condition, and standard biological information collected routinely when sampling Tanner crab.

Throughout the survey examine all red king crab for the parasitic rhizocephalan barnacle as part of standard sampling procedures (Spalinger and Cavin 2004). Barnacles invade and grow in the abdomen of king crab, causing sterilization, and have a stalk called an externa protruding from the underside of the crab's abdomen that is visible when lifting the crab's abdominal flap (Figure 2). Encountering a parasitic barnacle is rare, especially in males because their abdominal flap is not routinely opened. Carefully examine each king crab for parasitic barnacle externae and collect and preserve parasitized crabs. The first parasitized crab encountered in a bay will be preserved in ethanol, and any additional parasitized crabs will be frozen. Each crab will have a specimen collection form attached (Appendix D2).

GROUNDFISH SAMPLING

During survey tows in Marmot and Chiniak bays (Appendices A1 and A2) stomachs from walleye pollock, Pacific cod, flathead sole, arrowtooth flounder, Pacific halibut, northern rock sole, and spiny dogfish will be collected. Sample sizes are 15 to 40 stomachs depending on size

group (Appendix F1), with a maximum number of 20 stomachs per species per haul. The goal is to sample two to three species from every haul (Appendix F2).

Throughout the survey, from Kodiak Island to the Shumagin Islands, juvenile fish will be collected (Appendix G). Up to 40 specimens each of walleye pollock, sablefish, Pacific cod, arrowtooth flounder, and rockfish will be collected at each station where they are encountered according to procedures detailed in Appendix G3. No more than 40 individuals of each species should be taken from each collection area (Appendix G1). Specimens will be placed in plastic bags according to species and haul number with a completed specimen collection form (Appendix D2). A combined total for all species and areas of 1,000 specimens will be collected throughout the survey.

To assist with speciating rougheye and blackspotted rockfish distinctive differences are shown in Appendix H1. If there is discrete spotting on the first dorsal fin the fish should be called blackspotted rockfish.

The sex of each measured skate and shark will be determined. Males are easily identified by the presence of claspers (Figure 3). Small, immature skates and sharks that are difficult to sex will be recorded as unknown.

SPECIMEN COLLECTION

Selected species in the families Bathymasteridae, Stichaeidae, Pholidae, Cottidae, and Hemitripteridae will be collected for the University of Victoria, British Columbia, Canada (Table 1). Up to 6 individuals of each species will be bagged and frozen with completed specimen collection forms (Appendix D2). Although the trawl survey covers these species ranges, most are found in shallow or rocky habitats and unlikely to be captured by the survey. However, there are a few sculpin species likely to be encountered, the armorhead sculpin *Gymnocanthus galeatus*, scissortail sculpin *Triglops forficatus*, and the sculpins in the Hemitripteridae family.

Photos and collection of specimens (Table 2) will occur to update a marine fish and invertebrate field guide (Byersdorfer and Watson 2010). Organisms should be placed on a white or black background to show contrast, and multiple pictures should be taken of dorsal, ventral, and lateral views. Fins or legs should be spread as much as possible and close-up pictures of distinguishing characteristics taken. If identification of the organism is questionable the animal should be collected along with a completed specimen identification form (Appendix D2).

In any instance where the cruise leader is not certain of the species identification the animal should be photographed and frozen. All specimens should have a completed specimen collection form included in the bag.

DATA FORMS AND SAMPLE CUSTODY

Completion of data and proper disposition of samples is the same for the special projects and standard data. It is the cruise leader responsibility to ensure all samples and data forms are completed and removed from the boat after each survey leg. For projects continuing on the next leg, samples and data forms should be well organized, labeled, and dry. Forms are organized according to project and put into sequential order by tow, starting with the first tow on top. All data removed from the vessel is taken directly to Kally Spalinger, the lead trawl-survey biologist. Frozen samples must be labeled when removed from the R/V *Resolution* freezer and transferred

to one of the freezers at the Kodiak Fisheries Research Center, until they can be processed or shipped to their final destination. Samples preserved in formalin must be stored in a location with adequate ventilation until shipped. It is also important to inform the lead trawl-survey biologist of the location of all stored samples.

SPECIAL PROJECT EQUIPMENT CHECKLIST

Female Tanner Collection

- Specimen labels
- Tally sheets
- Plastic shopping bags
- Garbage bags

Genetic hemolymph collection

- 6 deep-well plates (96 wells of 1.2 ml capacity)
- Rubber well caps
- Syringes
- Syringe disposal containers
- Paper towels
- ADF&G Bitter Crab Sample Data Forms

Tanner Genetic Tissue Sampling

- Vials filled with ethanol
- Scissors
- Specimen number tags
- Crab data forms

King Crab Parasite Collection

- Buckets with ethanol
- Garbage bags
- Specimen collection forms

Stomach Sampling

- Specimen forms
- Specimen labels
- Tally sheets
- Five-gallon buckets with lids
- Formalin
- Stomach bags
- One-liter plastic bottles
- Baking soda
- Luggage tags
- 1/8 cup measuring cup
- Hazardous materials bucket

Juvenile Fish Sampling

- Ziploc bags
- Tally sheets
- Specimen collection forms

PERSONNEL AND SURVEY SCHEDULE

R/V Resolution crew – Captain Denis Cox Jr., Kurt Pederson, Gary Wilson

Chiniak Bay –
June 16 and 17

Kally Spalinger (cruise leader)
Dave Gilliland
Collin Hakkinen
Sherry Barker
Susan Aspelund

Marmot Bay –
June 21 to 25

Kally Spalinger (cruise leader)
Rob Baer
Dave Gilliland
Collin Hakkinen
Sherry Barker

Eastside Kodiak –
June 29 to July 15

Mark Stichert (cruise leader)
Dave Gilliland
Collin Hakkinen
Sherry Barker
Kim Phillips (Alitak)

South Alaska Peninsula, Chignik, and The Eastern Aleutians –
July 21 to August 26

Kally Spalinger (cruise leader)
Dave Gilliland
Collin Hakkinen
Sherry Barker
Britta Baechler (Aleutians)

Westside Kodiak and North Mainland –
September 6 to 16

Nicholas Sagalkin (cruise leader)
Dave Gilliland
Collin Hakkinen
Sherry Barker

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Jensen, P. C., K. Califf, V. Lowe, L. Hauser, and J. F. Morado. 2010. Molecular detection of *Hematodinium* sp. in Northeast Pacific *Chionoecetes* spp. and evidence of two species in the Northern Hemisphere. Diseases of Aquatic Organisms 89:155-166.

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TABLES

Table 1.–Specimen collection list for University of Victoria.

Common Name	Species name	Family	Number to collect[a]
Small-mouth ronquil	*Bathymaster leurolepis*	Bathymasteridae	up to 6
Alaskan ronquil	*Bathymaster caeruleofasciatus*	Bathymasteridae	up to 6
decorated warbonnet	*Chirolophis decoratus*	Stichaeidae	up to 6
mosshead warbonnet	*Chirolophis nugator*	Stichaeidae	up to 6
ribbon prickleback	*Phytichthys chirus*	Stichaeidae	up to 6
banded gunnel	*Pholus fasciata*	Pholidae	up to 6
brown Irish lord	*Hemilepidotus spinosus*	Cottidae	up to 6
leister sculpin	*Enophrys lucasi*	Cottidae	up to 6
Frog sculpin	*Myoxocephalus stelleri*	Cottidae	up to 6
armorhead sculpin	*Gymnocanthus galeatus*	Cottidae	up to 6
scissortail sculpin	*Triglops forficatus*	Cottidae	up to 6
crested sculpin	*Blepsias bilobus*	Hemitripteridae	up to 6
sailfin sculpin	*Nautichthys oculofasciatus*	Hemitripteridae	up to 6

[a] Contact Dr. Susan Crockford (scrock@uvic.ca) for shipping details at end of season.

Table 2.–List of species to photograph and collect for identification confirmation and inclusion in ADF&G field guides.

Common Name	Species	Common Name	Species
Salmon Shark	*Lamna ditropis*	Northern sun star	*Solaster endeca*
Unusual Skates		Morning sun star	*Solaster dawsoni*
Darkblotched Rockfish	*Sebastes crameri*	Evening sun star	*Solaster paxillatus*
Redstripe Rockfish	*Sebaster proriger*	Grooved sun star	*Crossaster borealis*
Bocaccio	*Sebastes paucispinis*	Greenland sea star	*Leptasterias groenlandica*
White-spotted greenling	*Hexagrammas stelleri*	Sheathed sea star	*Leptasterias stolocantha*
Ribbed sculpin	*Triglops pingelii*	Knobless 6-rayed star	*Leptasterias hexactic*
Brown Irish lord	*Hemilepidotus spinosus*	White sea urchin	*Strongylocentrotus pallidus*
Longfin Irish lord	*Hemilepidotus zapus*	Purple urchin	*Strongylocentrotus purpuratus*
Butterfly sculpin	*Hemilepidotus papilio*	Slender sole	*Eopsetta exilis*
Fourhorn sculpin	*Myoxocephalus quadricornis*	Sand sole	*Psettichthys melanostictus*
Arctic sculpin	*Myoxocephalus scorpioides*	Spinycheek starsnout	*Bathyagonus infraspinatus*
Warthead sculpin	*Myoxocephalus niger*	Spectacled sculpin	*Triglops scepticus*
Frog sculpin	*Myoxocephalus stelleri*	Pacific staghorn sculpin	*Leptocottus armatus*
Small-mouth ronquil	*Bathymaster leurolepis*	Thorny sculpin	*Icelus spiniger*
Northern ronquil	*Ronquilus jordani*		*Aequorea sp.*
	Lycodes polaris		*Cynaea sp.*
	Lycodes raridens	Barbed eualid	*Eualus barbatus*
	Lycodes diapterus		*Eualus suckleyi*
	Lycodes concolor		*Crangon communis*
	Bothrocara brunneum		*Crangon dalli*
	Lycodaptus mandibularis	Shouldered whelk	
Slender eelblenny	*Lumpenus medius*		*Beringius undatus*
Daubed shanny	*Lumpenus maculates*	Stefansson's melon snail	*Volutopsius stefanssoni*
Wolf eel	*Anarchichthys ocellatus*	Keeled aforia	*Aforia circinata*
Bering flounder	*Hippoglossoides robustus*		*Gephryseaster swifti*
Giant rock scallop	*Crassadoma gigantes*		*Hippasteria spinosa*
Spiny scallop	*Chlamys hastate*		*Mediaster aequalis*
Island scallop	*Chlamys islandica*		*Luidia foliolata*
Flat-tip piddock	*Penitella penita*		*Dipsacaster sp.*
Chimney piddock	*Penitella penita*		
any new shrimps			
Setose hermit	*Pagurus setosus*		
Bluespined hermit	*Pagurus kennerlyi*		
Pribilof hermit	*Pagurus undosus*		
Long-hand hermit	*Pagurus tanneri*		
Horny-hand hermit	*Pagurus cornutus*		

FIGURES

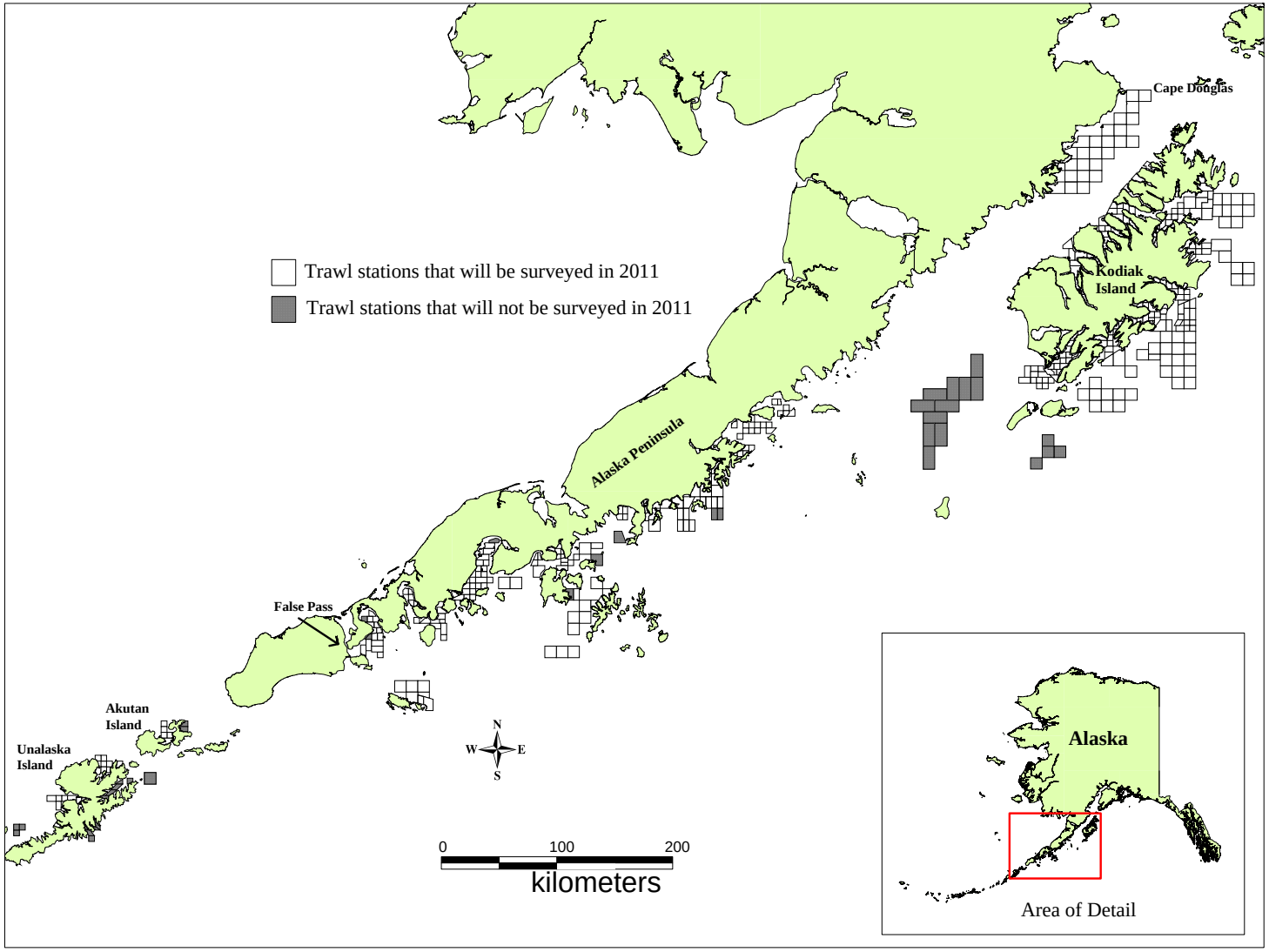


Figure 1.–Westward Region trawl survey area, 2011.

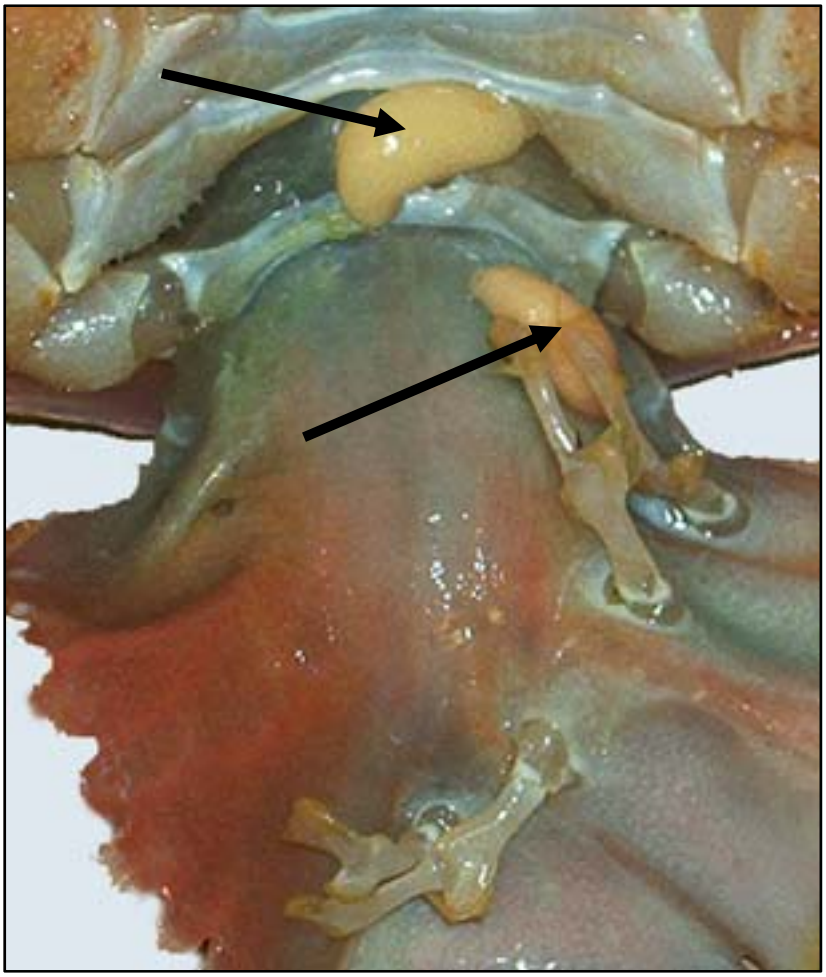


Figure 2.–Rhizocephalan barnacle parasite on a king crab abdominal flap.

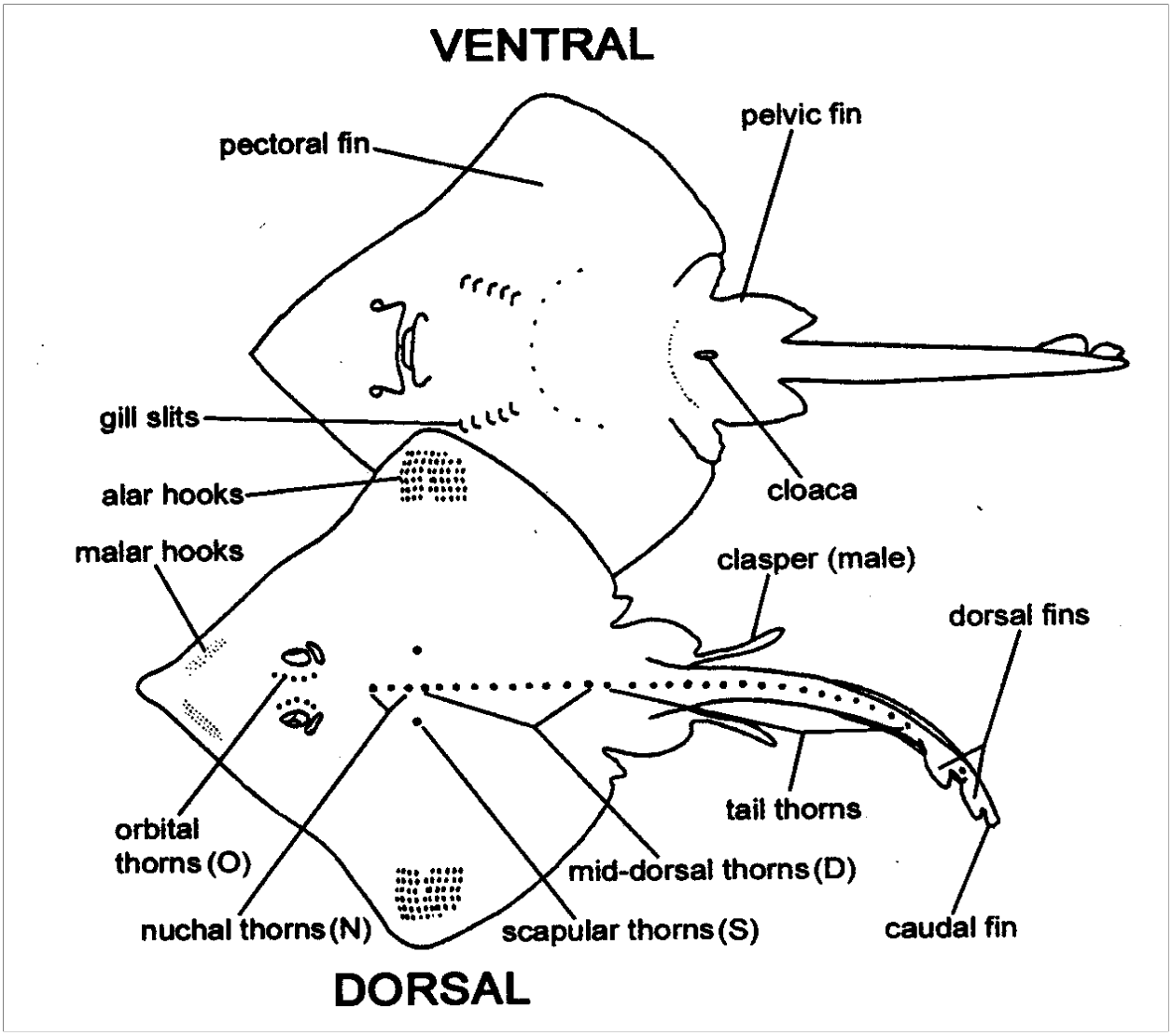
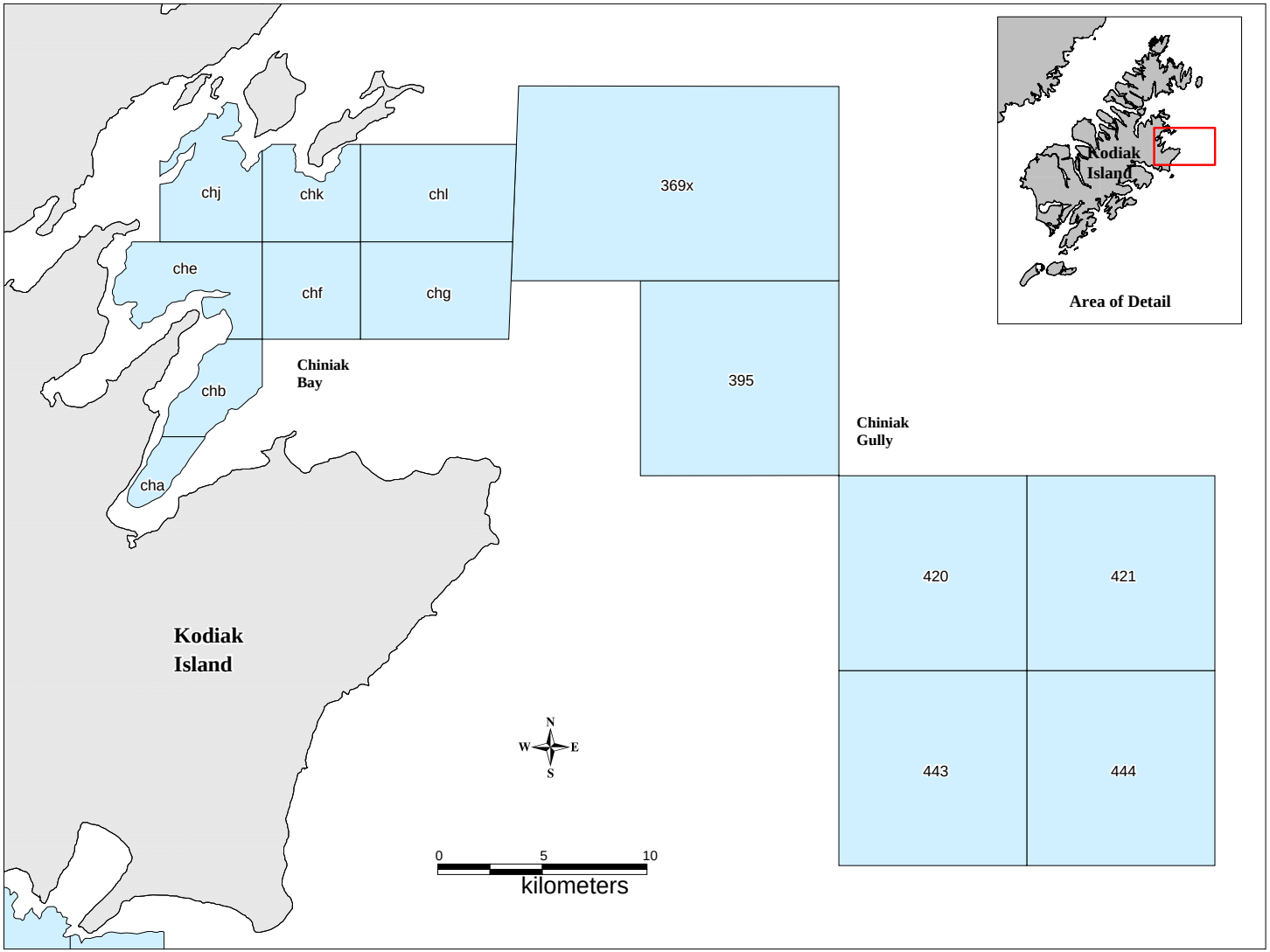
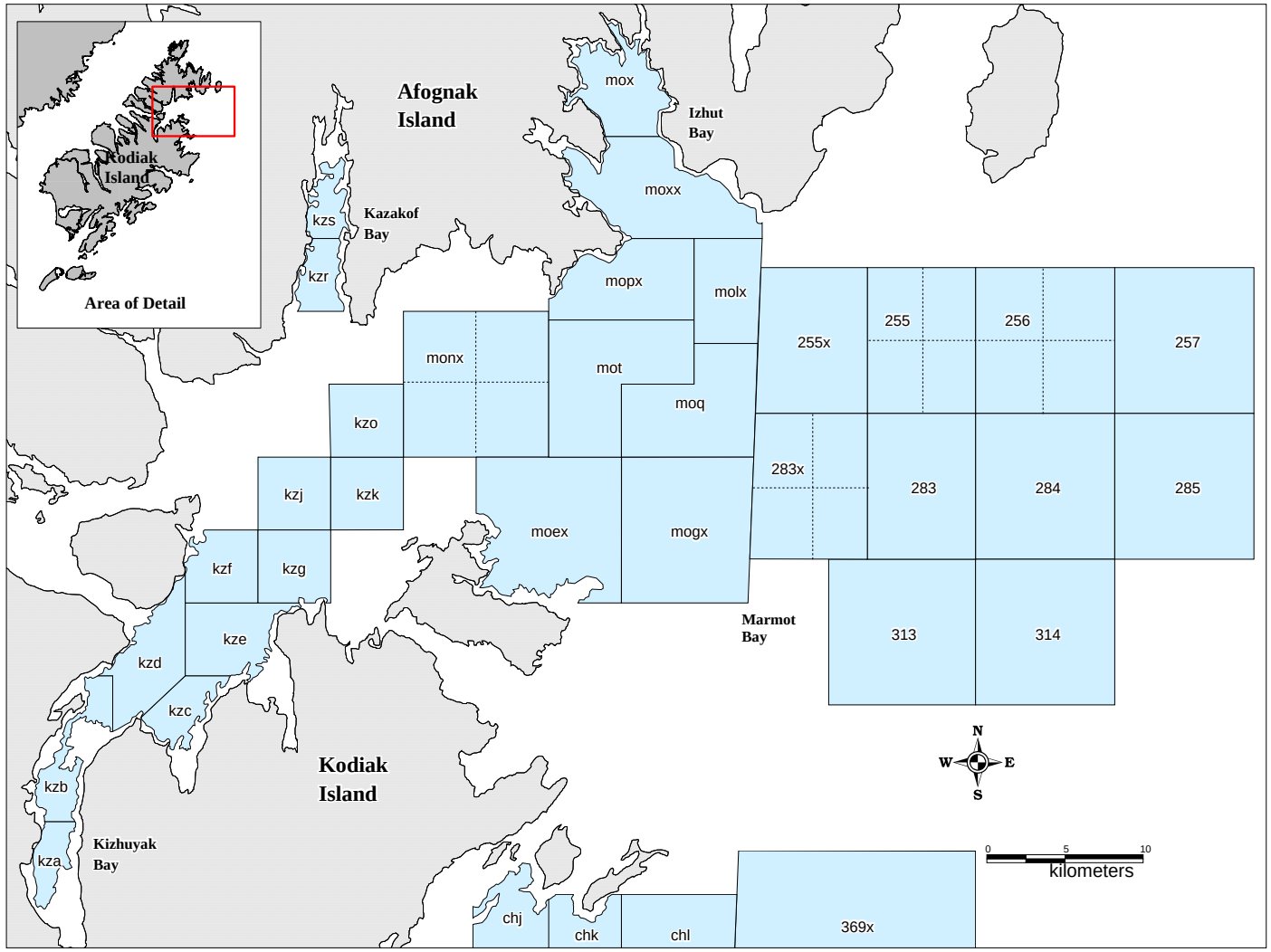


Figure 3.–Basic external skate (top) and shark (bottom) anatomy

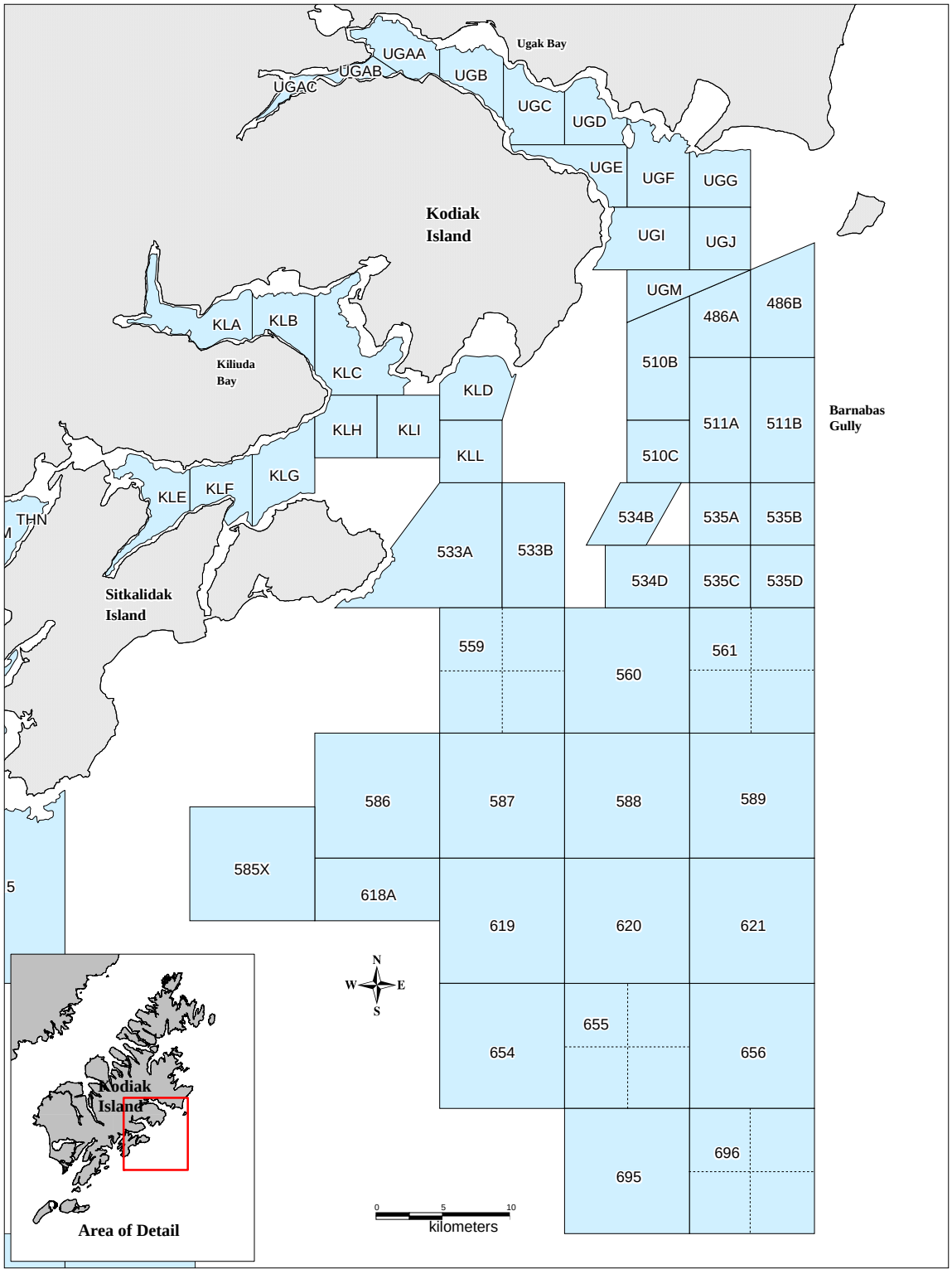
APPENDIX A. TRAWL SURVEY STATION MAPS



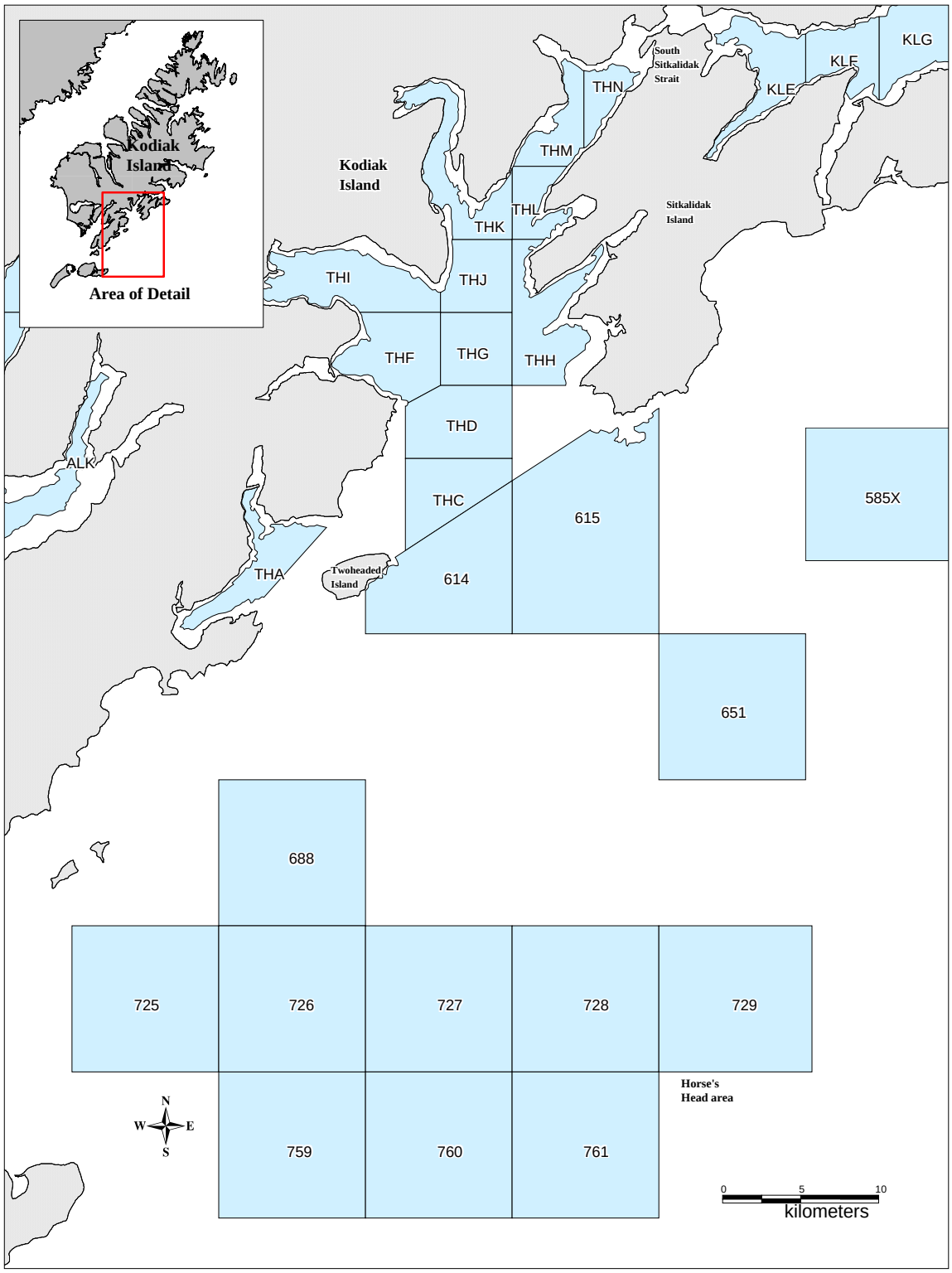
Appendix A1.–Station boundaries and names, Chiniak Bay and Chiniak Gully, 2011 Kodiak District trawl survey.



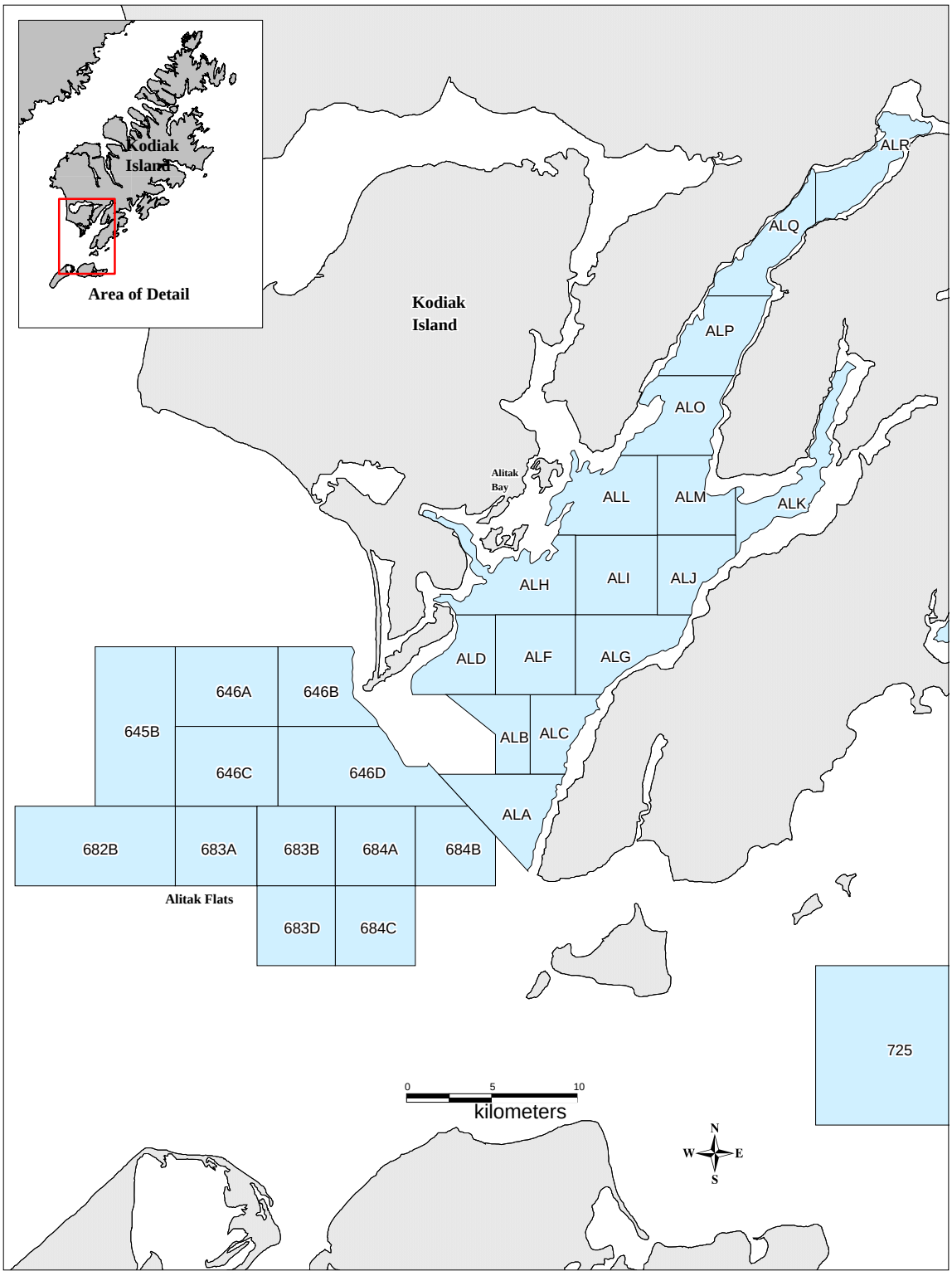
Appendix A2.–Station boundaries and names, Izhut, Kazakof, Kizhuyak, and Marmot bays, 2011 Kodiak District trawl survey.



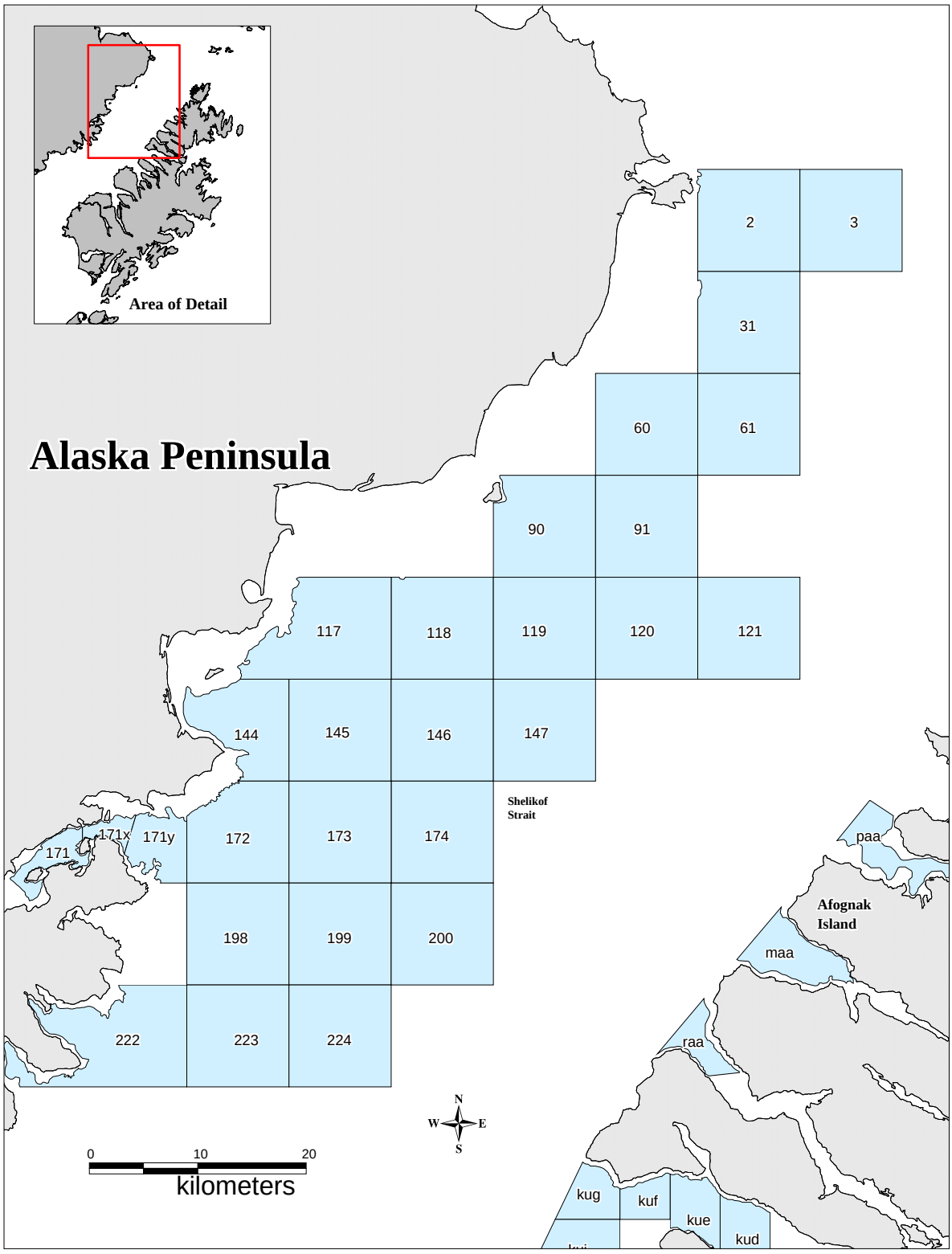
Appendix A3.–Station boundaries and names, Ugak Bay, Kiliuda Bay, and Barnabas Gully, 2011 Kodiak District trawl survey.



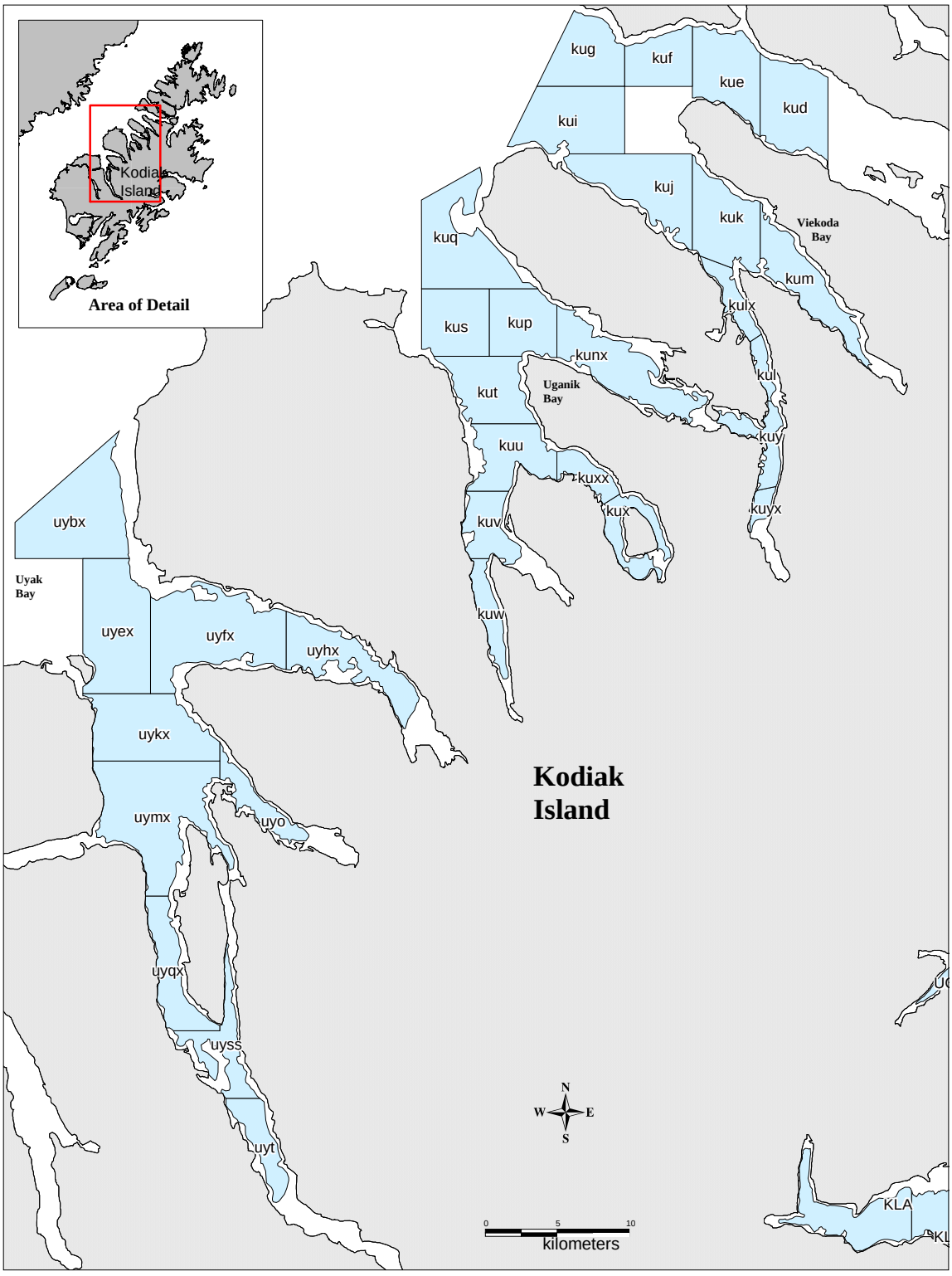
Appendix A4.–Station boundaries and names, South Sitkalidak Strait, Two Headed Island, and Horse's Head area, 2011 Kodiak District trawl survey.



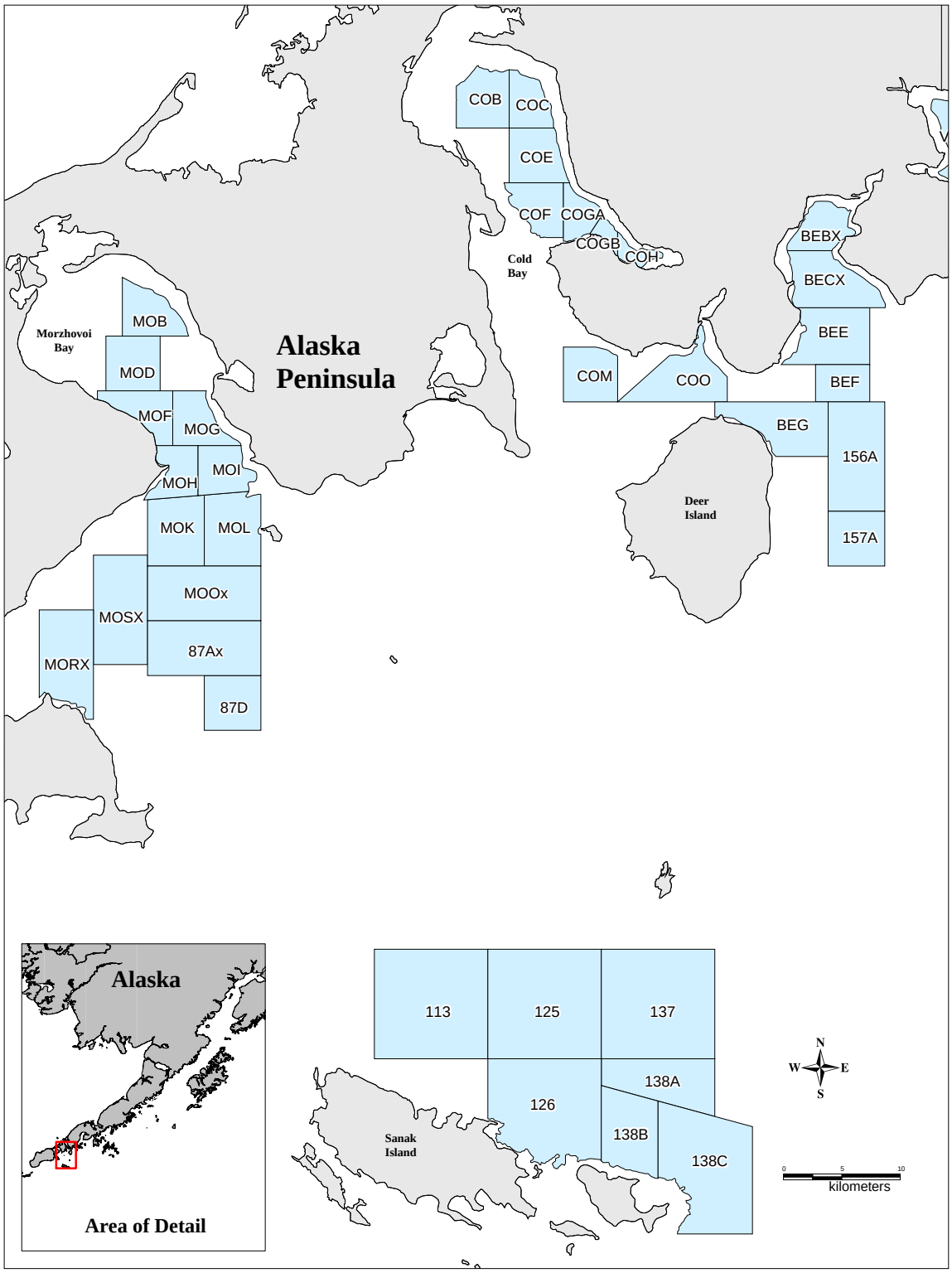
Appendix A5.–Station boundaries and names, Alitak Bay and Alitak Flats, 2011 Kodiak District trawl survey.



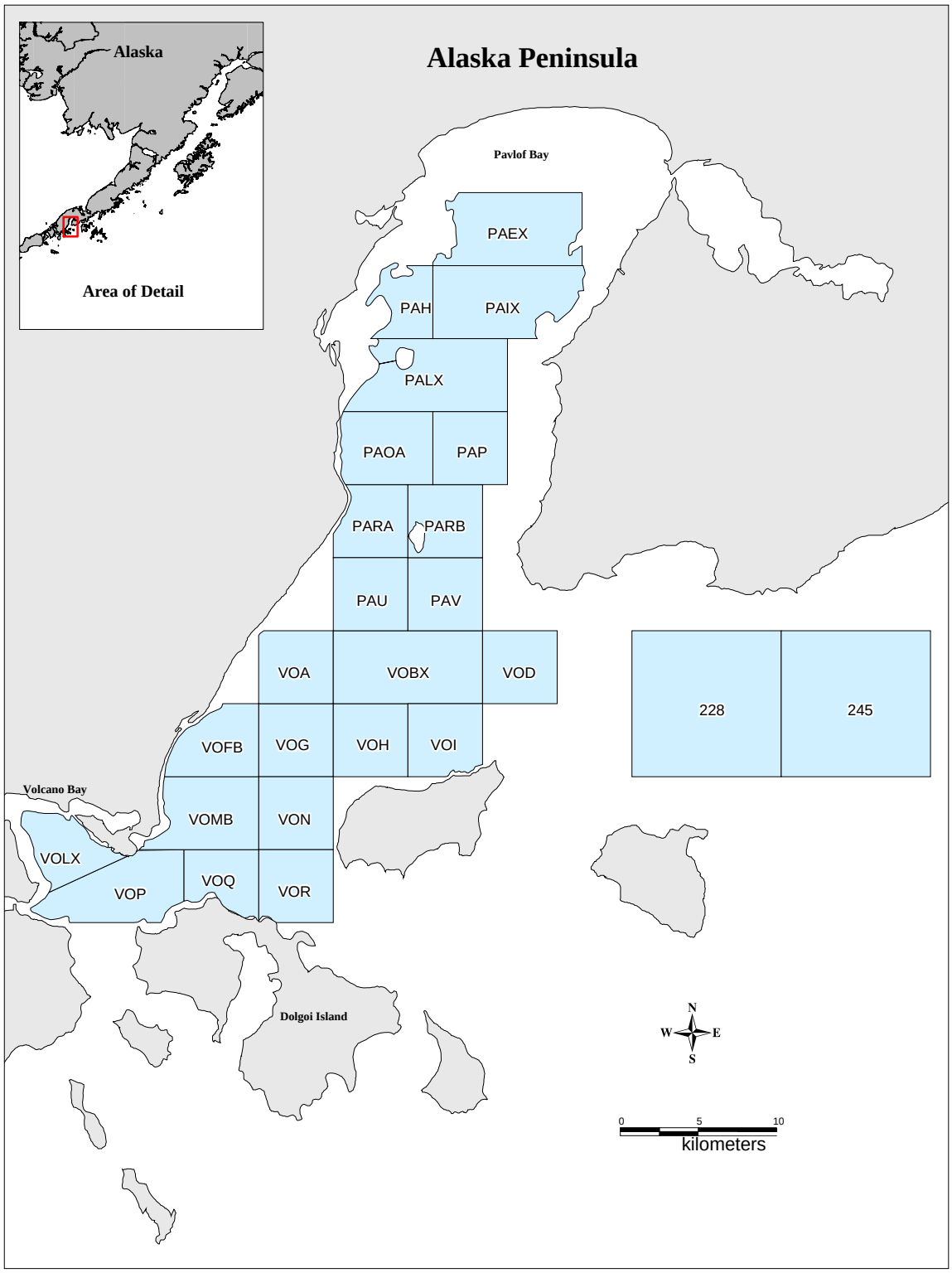
Appendix A6.–Station boundaries and names, Shelikof Strait, 2011 Kodiak District trawl survey.



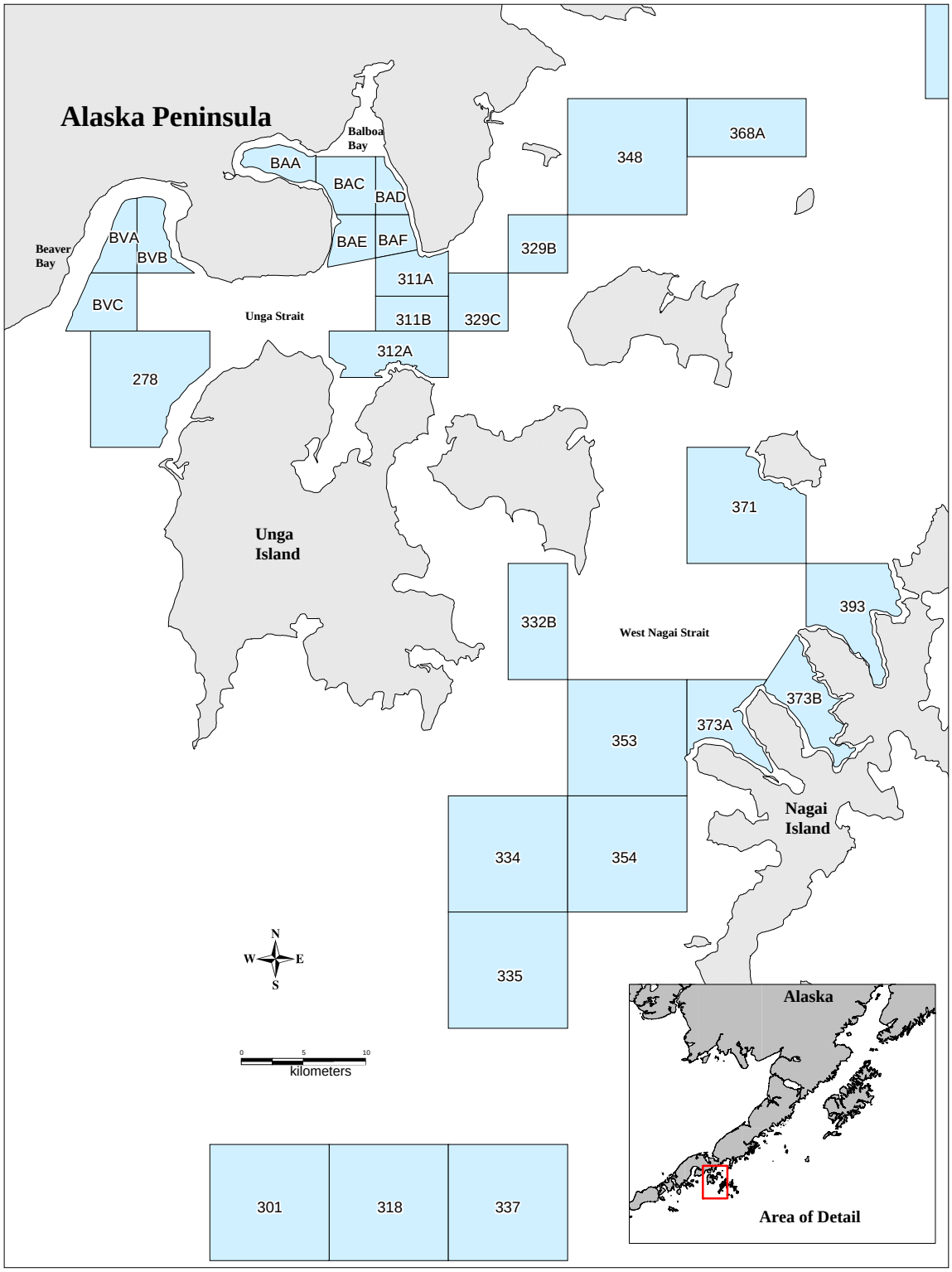
Appendix A7.–Station boundaries and names, Uyak, Uganik, and Viekoda bays, 2011 Kodiak District trawl survey.



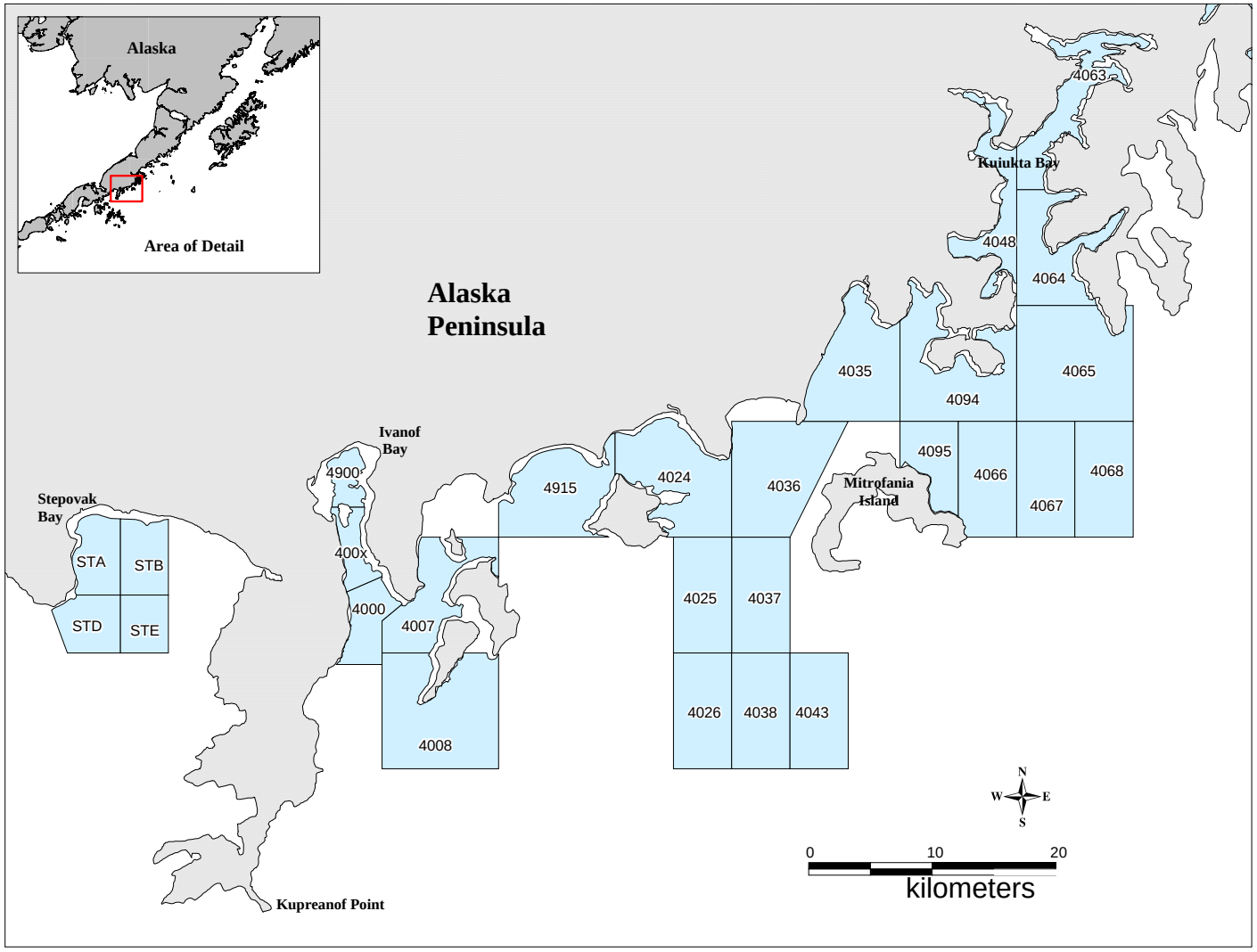
Appendix A8.–Station boundaries and names, Morzhovoi Bay, Cold Bay, Deer Island, and Sanak Island, 2011 South Peninsula District trawl survey.



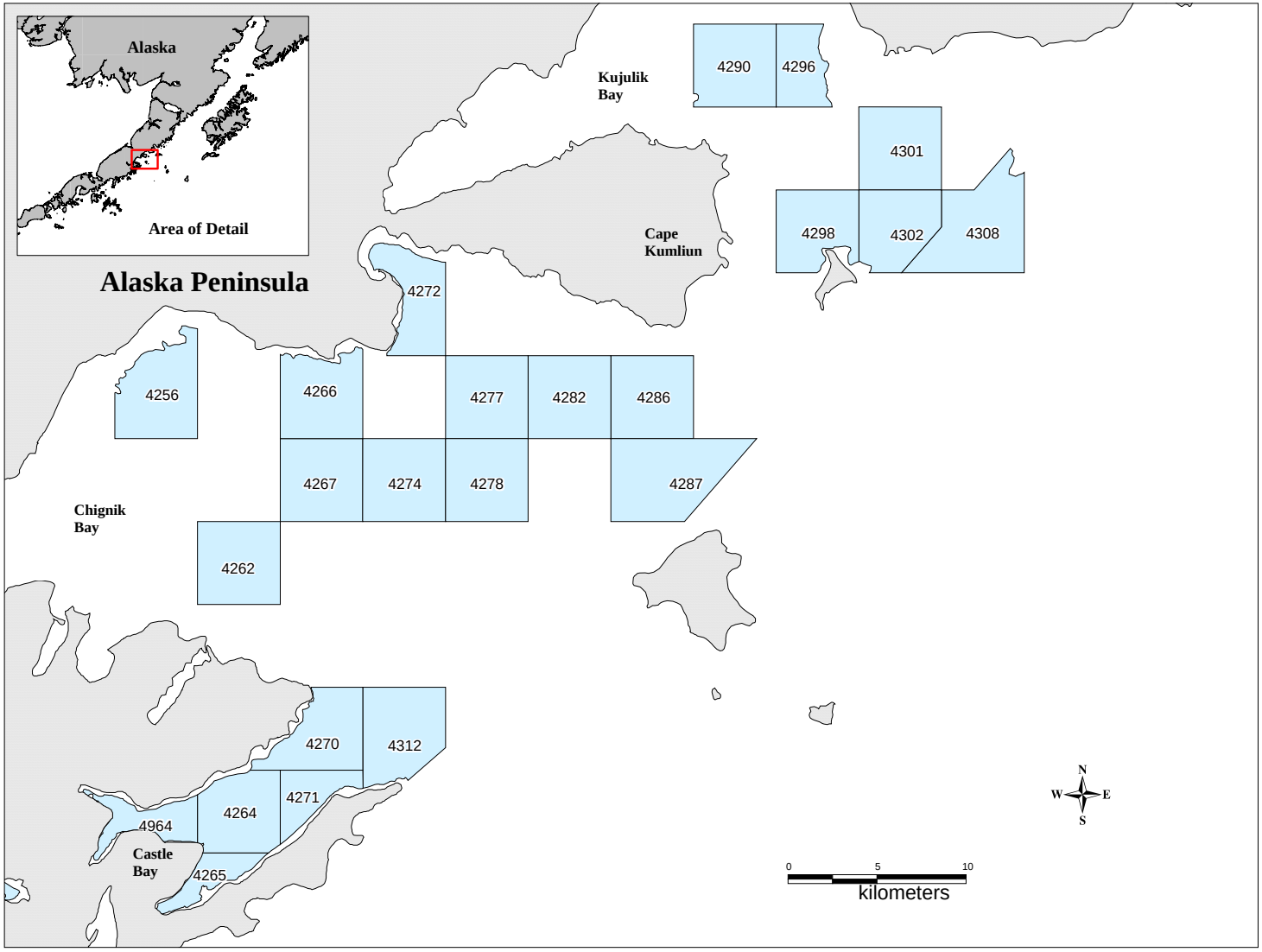
Appendix A9.–Station boundaries and names, Pavlof and Volcano bays, 2011 South Peninsula District trawl survey.



Appendix A10.–Station boundaries and names, Unga Strait, Beaver Bay, Balboa Bay, and West Nagai Strait, 2011 South Peninsula District trawl survey.

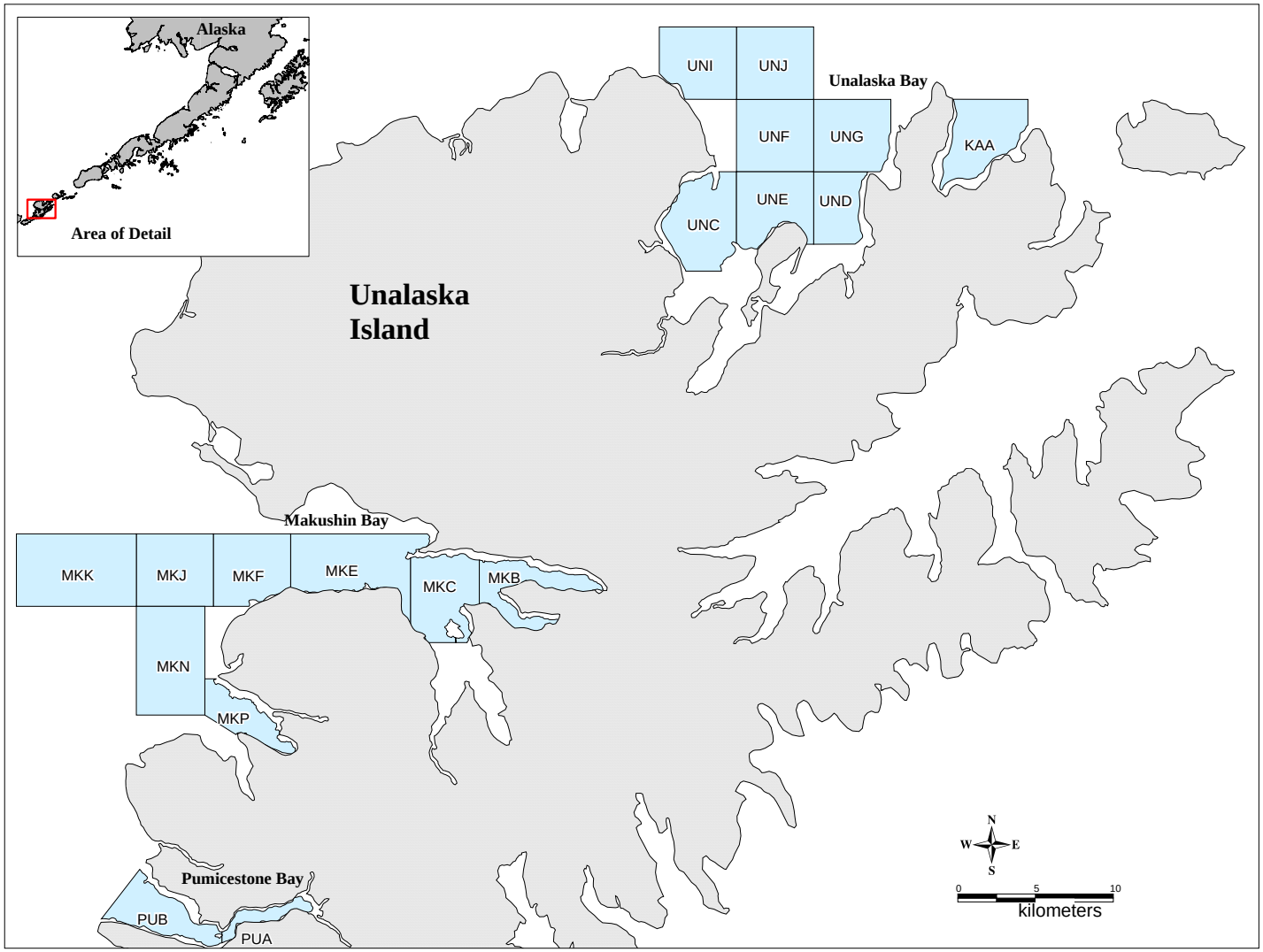


Appendix A11.–Station boundaries and names, Stepovak Bay, Ivanof Bay, Mitrofania Island, and Kuiukta Bay, 2011 South Peninsula and Chignik District trawl survey.



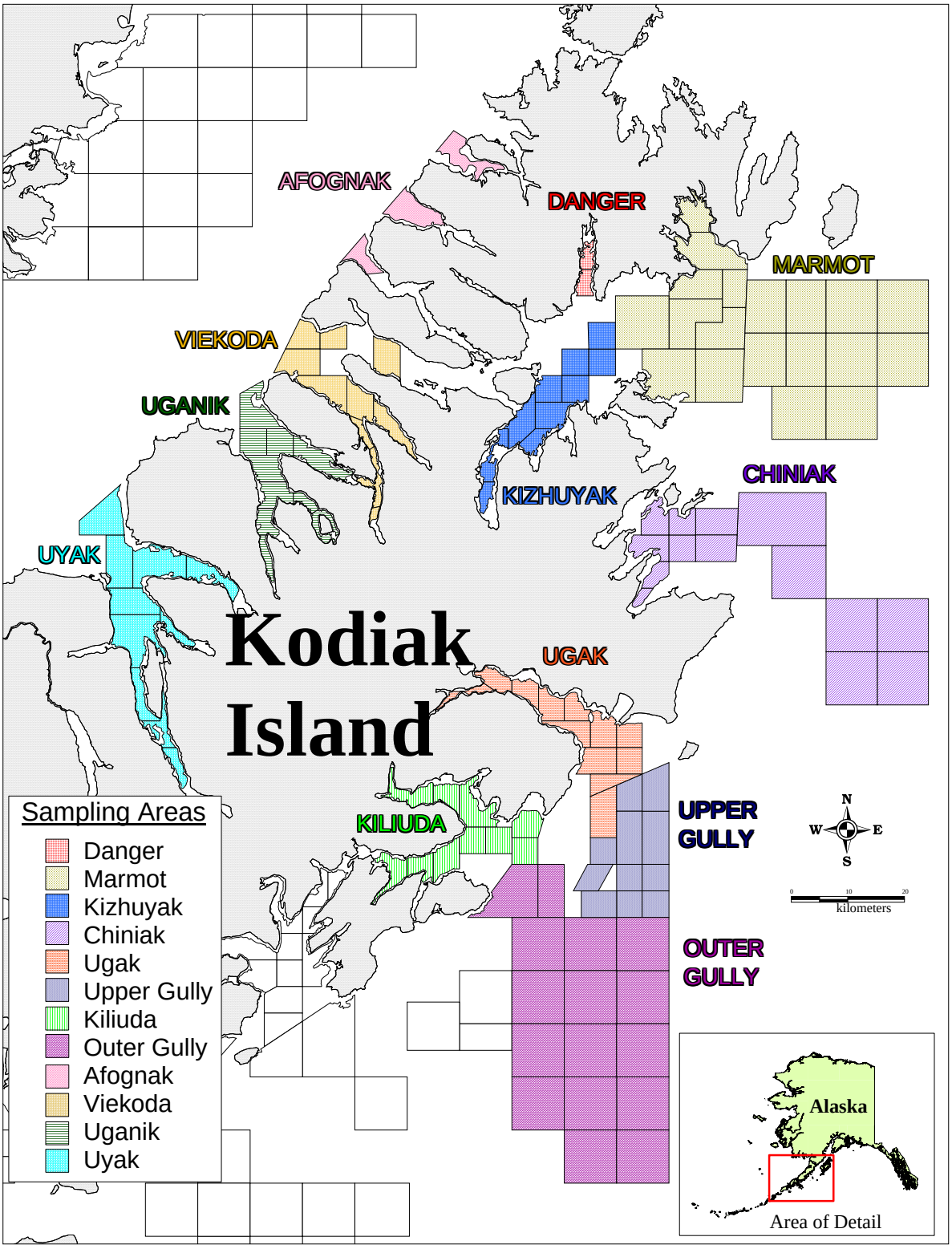
Appendix A12.–Station boundaries and names, Kujulik, Chignik, and Castle bays, 2011 Chignik District trawl survey.

Appendix A13.–Station boundaries and names, Akutan Bay, 2011 Eastern Aleutian District trawl survey.



Appendix A14.–Station boundaries and names, Unalaska, Makushin, and Pumicestone bays, 2011 Eastern Aleutian District trawl survey.

APPENDIX B. MATURE FEMALE TANNER CRAB COLLECTION



Appendix B1.–Sampling areas for mature female Tanner crab collection.

Appendix B2.–Stations to be considered part of each sampling area for mature female Tanner crab collection.

NORTHEAST

Danger Bay:
KZS, KZR

Marmot:
MOX, MOXX, MONX, MOPX, MOLX, MOT, MOQ, MOEX, MOGX, 255X, 255, 256, 257, 283X, 283, 284, 285, 313, 314

Chiniak:
CHA, CHB, CHE, CHJ, CHF, CHK, CHL, CHG, 369X, 395, 420, 421, 443, 444

Kizhuyak:
KZA, KZB, KZC, KZD, KZE, KZF, KZG, KZK, KZJ, KZO

EASTSIDE

Ugak:
UGAC, UGAB, UGAA, UGB, UGC, UGD, UGE, UGF, UGG, UGI, UGJ, UGM, 510B

Upper Gully:
486A, 486B, 510C, 511A, 511B, 534B, 534D, 535A, 535B, 535C, 535D

Kiliuda:
KLA, KLB, KLC, KLD, KLE, KLF, KLG, KLH, KLI, KLL

Outer Gully:
559, 560, 561, 587, 588, 589, 619, 620, 621, 654, 655, 656, 695, 696

WESTSIDE

Uganik:
KUQ, KUS, KUP, KUT, KUNX, KUU, KUXX, KUV, KUW, KUX

Viekoda:
KUD, KUF, KUG, KUI, KUJ, KUK, KUM, KULX, KUL, KUY, KUYX

Uyak:
UYBX, UYEX, UYFX, UYHX, UYKX, UYMX, UYO, UYQX, UYSS, UYT

Afognak:
RAA, MAA, PAA

Appendix B3.–Sample sizes for mature female Tanner crab collection by sampling area and maturity.

Northeast									
Size	Danger Bay		Marmot		Chiniak		Kizhuyak		
CW (mm)	Primiparous	Multiparous	Primiparous	Multiparous	Primiparous	Multiparous	Primiparous	Multiparous	Total
<75	15	15	15	15	15	15	15	15	120
75-89	15	15	15	15	15	15	15	15	120
≥90	15	15	15	15	15	15	15	15	120
									360

Eastside									
Size	Ugak Bay		Upper Gully		Kiliuda Bay		Outer Gully		
CW (mm)	Primiparous	Multiparous	Primiparous	Multiparous	Primiparous	Multiparous	Primiparous	Multiparous	Total
<75	15	15	15	15	15	15	15	15	120
75-89	15	15	15	15	15	15	15	15	120
≥90	15	15	15	15	15	15	15	15	120
									360

Westside									
Size	Uganik		Viekoda		Uyak		Afognak		
CW (mm)	Primiparous	Multiparous	Primiparous	Multiparous	Primiparous	Multiparous	Primiparous	Multiparous	Total
<75	15	15	15	15	15	15	15	15	120
75-89	15	15	15	15	15	15	15	15	120
≥90	15	15	15	15	15	15	15	15	120
									360

Note: Primiparous = new shell, first clutch; Multiparous = old/very old shell, has had previous clutch(es).

APPENDIX C. TANNER CRAB HEMOLYMPH COLLECTION: PROTOCOL FOR GENETIC SAMPLING

Preparation

1. **6 well plates will be needed for hemolymph sample collection from 480 crabs in Alitak Bay.**
2. **Pre-fill each well with 0.8 ml of biotechnology grade ethanol**
    a. Leave the last two columns (11 and 12) of each plate empty. These will be used as controls in the laboratory.
3. **Press the rubber caps onto each filled well**
4. **Label the plates consecutively and color code the top left corner - well A1 (with all trays oriented the same way) to denote the starting position**
    a. The plates are labeled across the top with numbers and down one side with letters.
    b. They should be filled from left to right, starting with A1.
5. **Wrap a rubber band around the plate to move down one row at a time as you fill wells with samples**
6. **Completely fill out all applicable header information on the ADF&G Bitter Crab Sample Data Form (Appendix B2).**
    a. Instructions on filling out the form can be found on page 2 of Appendix D1.

Sample Collection

The same 30 crabs used to make hemolymph smears for visual bitter crab disease determination (Spalinger and Cavin 2004) will be used for genetic sampling and the methods used to collect hemolymph are the same.

1. **Arrange crab on table in way to facilitate sampling and reduce error.**
    a. Typically I will set up 5 crab at a time. It is easier to keep track of and a handy multiple of 30.
    b. If you place the crabs carapace up, with their mouths facing right, it will expose the preferred sampling leg, the right cheliped.
    c. Wipe the joint membrane clean with a paper towel so extraneous material does not contaminate the sample.
2. **Using a new syringe freshly out of its wrapper for each crab, draw hemolymph from the elbow joint of the right cheliped.**

    a. Slightly raise stopper on syringe before inserting needle.
    b. Being careful not to puncture yourself insert needle into joint, about halfway, or far enough to ensure angled hole in needle is inside crab tissue.
    c. Raise stopper just until you see semi-clear fluid being drawn into syringe. If you can see it, you have enough. If the crab is heavily infested with BCS it may be more difficult to draw hemolymph.
    d. Small crabs may be more difficult. You may have to try drawing blood from a different leg, particularly if the preferred leg is injured.

-continued-

3. **Make a blood smear on a slide for visual examination in the laboratory (Spalinger and Cavin 2004).**
    a. This smear only requires a drop or two of hemolymph, so enough should remain in the syringe for genetic sampling purposes.
    b. It is important to finish the blood smear before inserting the needle into the well containing ethanol, as ethanol remaining on the tip of the needle could dilute the hemolymph resulting in an inadequate amount of cells for visual examination.
4. **With the syringe, inject 0.2 ml of hemolymph into each well** (one well per crab)
    a. Fill wells from left to right, then top to bottom, like reading a book.
    b. If you inject too much hemolymph, or a lot of air, the cap may pop off the well and spray hemolymph/ethanol over adjacent caps.
    c. To mix the blood and ethanol, invert the plate once in a while
5. **Complete the information on the ADF&G crab data form.**
    a. Instructions on filling out the form can be found on page 2 of Appendix D1.
6. **After verifying that all information has been recorded and that the correct sample number and PCR well number is written you can discard the crab.**
    a. Always check with the on-deck leader before discarding crab over the side. Weights and sizes still need to be accounted for in the haul data.
7. **At the end of the haul coordinate with the on-deck leader to determine how data from crab sampled for BCS will be handled.**
    a. If all crab in the haul were measured and counted (whole-hauled), then enter the data from the BCS sample forms into the crab database.
        1. The easiest way to do this is to use the on-deck computer.
    b. If crab were subsampled, The weight from the BCS sample should be removed from the on-deck form, and only those crab actually in the subsample should be included in the crab database.
    c. If other sampling methods were used (i.e. %m/f) it is the cruise leaders responsibility to ensure that the crab being sampled for BCS are properly accounted for.

APPENDIX D. DATA FORMS

ADF&G BITTER CRAB SAMPLE DATA FORM

SPECIES ____ STATION NUMBER _____

VESSEL TRAWL HAUL NUMBER _____

DATE ____-__-__-__ SURVEY NUMBER _____ Page _____ of _____

	SEX CODE	LEGAL CODE	FEM MATURITY	CARAPACE SIZE (MM)	SHELL	DISEASE	CLUTCH FULL-NESS	CLUTCH CONDITION	CLUTCH EGG DEVEL	BCS SLIDE NO. SAMPLER INITIALS	PCR WELL NO. SAMPLER INITIALS	PCR TRAY NO	COMMENTS	BCS SLIDE RESULT LAB USE
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

SPECIES
2. P. CAMTSCHATICUS
6. C. BAIRDI
9. C. MAGISTER

SEX CODE
1 Male
2. Female

LEGAL CODE
0. Sublegal Male
2. Legal Male (returned to water after sampling)

FEMALE MATURITY
1 Juvenile Female
2. Adult Female

SHELL CONDITION
1 Soft
2. New
3. Old
4. Very Old

DISEASE CODE
1 Parasitic barnacle
2. Nemertean worms
3. Bitter crab
5. Black Mat

EGG DEVELOPMENT
1 Uneyed eggs
2. Eyed eggs
3. Hatching-eyed eggs and empty egg cases

CLUTCH FULLNESS
0. empty
1 trace to 1/8
2. 1/8 to 1/4
3. 1/4 to 1/2
4. 1/2 to 3/4
5. 3/4 to full

CLUTCH CONDITION
1 Dead Eggs Not Apparent
2. Dead Eggs < 20%
3. Dead Eggs > 20%
4. Barren with Clean "Silky" Se
5. Barren with "Matted" setae empty Egg Cases
6. Barren with no visible setae

○ Check here when crab data has been entered into crab database

-continued-

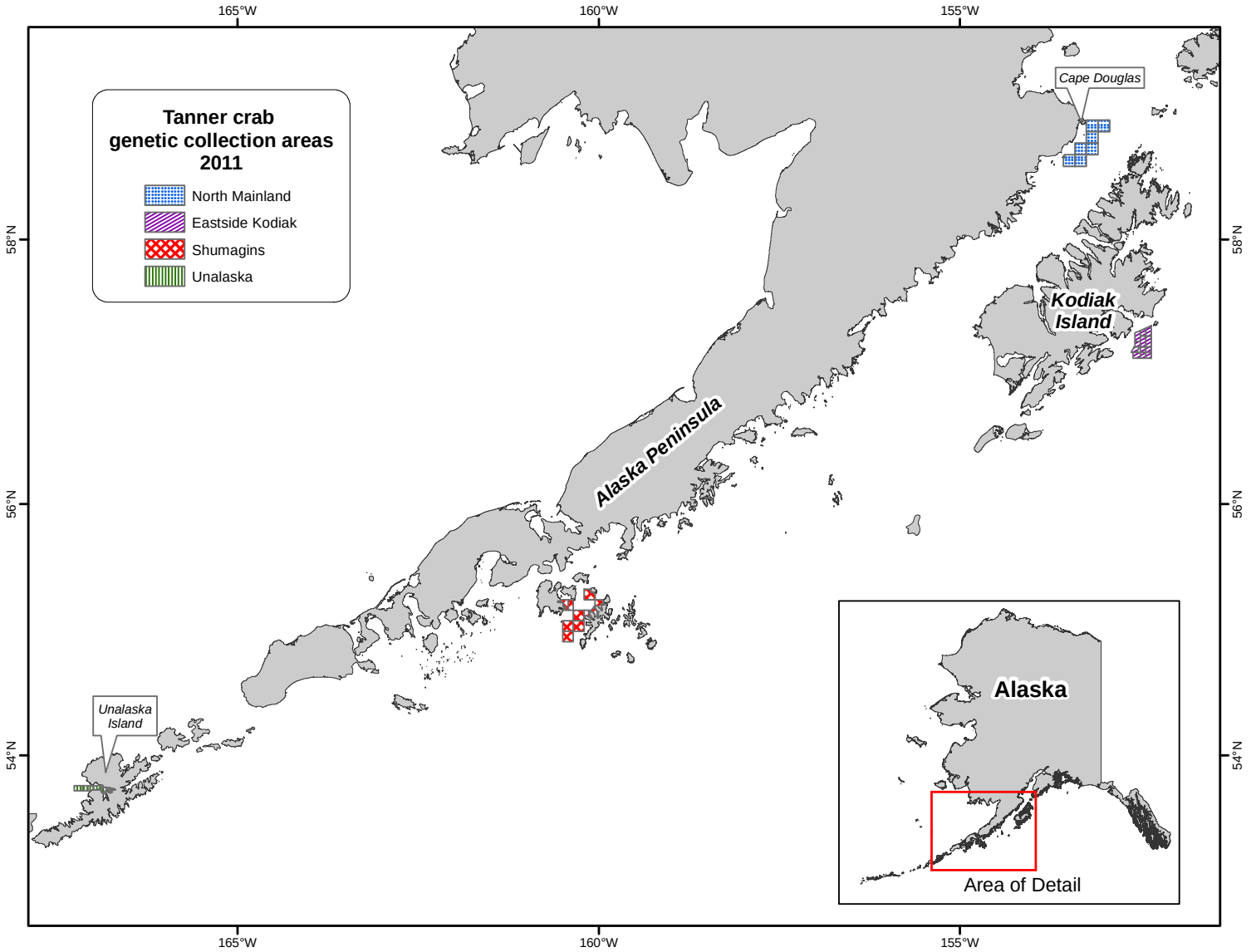
ADF&G Bitter crab sample data form

Species	Use the numeric codes from the bottom of the form, and write in the common name of the crab species being sampled.
Vessel	Name of vessel samples were collected from.
Date	Month, day, and year.
Station number	The name of the station the crabs are from. (May be completed later using haul number)
Trawl haul number	Fill in the haul number where the crabs were captured.
Survey number	The 2010 large-mesh survey is number "1001"
Page___of___	If multiple pages required for samples from the location, note here.
Sex code	Use codes from bottom of form
Legal code	Males only Use codes from bottom of form If the crab is legal and retained (fishery, sample collection, etc. use code 1)
Fem(ale) Maturity	Females only Use codes from bottom of form
Carapace Size	Distance across the carapace between spines, in mm, for Tanner and Dungeness. Distance from right eye socket to the middle of the posterior margin of the carapace for king crab.
Shell (condition)	Use codes from bottom of form
Disease	Use codes from bottom of form Note additional diseases or parasites in the comments
Clutch fullness	Use codes from bottom of form
Clutch condition	Use codes from bottom of form
Egg development	Use codes from bottom of form
BCS slide number	The sequential number of the slide with the hemolymph smear. Include the initials of the sampler making the smear
PCR well number	The location of the well containing the hemolymph sample for genetic testing (i.e. A1, B1, etc.) Include the initials of the sampler depositing the sample into the wells.
PCR tray number	The sequential number of the PCR tray that the sample is in.
Comments	Sampling notes or items of interest (diseases/parasites)
BCS slide result	Leave blank in the field. To be used when examining the slide under a microscope.
Check box at bottom	This circle should be checked after the data have been transferred to the main database.

Specimen collection form *R/V Resolution*
Species (suspected):
Date:
Haul Number:
General Location:
Collector:
Photo Taken? **yes** **no** file location:
Reason for collection: ☐ Confirm ID ☐ Special Project ☐ Guide Inclusion other (specify) _____

Species (suspected)	Name of organism(s) being collected, or the best guess if unknown
Date	Month, day, and year
Haul Number	The haul number where the organism(s) were captured
General Location	Name of bay, gully, or area where haul occurred
Collector	Name of person collecting the organism(s)
Photo Taken?	Circle “yes” or “no”. If “yes” then record the location the picture file will be saved.
Reason for collection	Check the appropriate box, or complete the “other” line. If collecting for a special project, include a project description.

APPENDIX E. TANNER CRAB GENETIC TISSUE COLLECTION



Appendix E1.–Sampling areas for Tanner crab genetic tissue collection, 2011.

Appendix E2.–Stations to be considered part of each sampling area for Tanner crab genetic tissue collection.

North Mainland:
2, 3, 31, 60, 61, 90, 91

Eastside Kodiak:
486A, 486B, 510B, 510C, 511A, 511B, 534B, 534D, 535A, 535B, 535C, 535D

Shumagins:
332B, 334, 335, 353, 354, 371, 373A, 373B, 393

Unalaska:
MKB, MKC, MKE, MKF, MKJ, MKK, MKN, MKP

APPENDIX F. GROUNDFISH STOMACH SAMPLING PROTOCOL

Appendix F1.–Number of stomachs, by species and size groups (cm), to be collected in the 2011 Chiniak and Marmot bays summer survey.

Species	Number	Species	Number
Walleye pollock		**Arrowtooth flounder**	
< 30 cm	20	< 30 cm	40
30-44	20	30-49	40
45-54	40	≥ 50	40
≥ 55	40	**total**	**120**
total	**120**		
Pacific cod		**Pacific halibut**	
< 30 cm	20	< 40 cm	15
30-44	20	40-54	15
45-59	40	55-69	30
≥ 60	40	≥ 70	30
total	**120**	**total**	**90**
Flathead sole		**Northern rock sole**	
< 20 cm	20	< 20 cm	20
20-39	20	20-39	20
≥ 40	20	≥ 40	20
total	**60**	**total**	**60**
Spiny dogfish			
< 40 cm	20		
40-79	20		
≥ 80	20		
total	**60**		

Appendix F2.–2011 Chiniak and Marmot bays groundfish stomach sampling protocol.

At every haul, after the catch has been dumped in the bin and the major species in the catch are evident, choose two to three species from Appendix E1 which are abundant enough for stomach sampling purposes (about one full basket). With the concurrence of the sorting crew, designate which specimens are to be set aside for stomach dissection after the baskets have been weighed. Set the baskets in a cool, shaded area until the rest of the catch has been processed.

Sampling procedures:

(1) Collect fish that show **no** sign of either net feeding or regurgitation.
*Signs of net feeding and regurgitation (DO NOT KEEP THESE):
-prey items in mouth or gill rakers
-flaccid (loose and bloated) looking stomach
*Signs of "natural" stomachs (KEEP THESE!):
-naturally empty stomachs appear tight and contracted
-stomachs appear tight around any prey inside

(2) If the fish is determined to be collectable, measure the fork length, determine the sex and spawning condition, excise the stomach and place in a stomach bag with a label. Try to collect 5 specimens from each size group (e.g. collect 5 stomachs from each of the <30 cm, 30-44 cm, 45-54 cm, and ≥55 cm pollock) in one haul. For small fish (≤20 cm), do not excise the stomach but instead make a slit in the body cavity to allow penetration of Formalin to the gut. Place the samples of whole fish in a large stomach bag with a label. Submerge samples in a bucket of 10% buffered Formalin. To make the Formalin solution, fill a 5-gallon bucket about half full with sea water, then add one liter 37% Formalin to the bucket. Add one rounded 1/8 cup of baking soda per bucket.

(3) Each stomach bag should contain a specimen label which records the species, vessel, cruise, haul, specimen number, the fork length of the fish, sex, and the spawning condition (spawning=1 or not spawning=0).

(4) For each species, start specimen number at "1" and assign a number consecutively until the end of the cruise.

(5) A specimen form is also filled out for each species in each haul. The specimen form should record the species, vessel, cruise, haul, fork length, sex, spawning condition (spawning or non-spawning), date, and specimen number (individual fish weight does not have to be taken).

(6) Use the broken lids to cover the bucket each time you add some stomach collections into it. Seal the bucket (by using the unbroken lid) only when the bucket is full or at the end of the cruise.

(7) Put different species collections in different buckets. Use the permanent mark pen to write the species name, vessel, the address (National Marine Fisheries Service, Food Habits Lab, Bldg. 4, 7600 Sand Point Way NE, Seattle, WA 98115-0070) on the unbroken lid each time you seal a bucket.

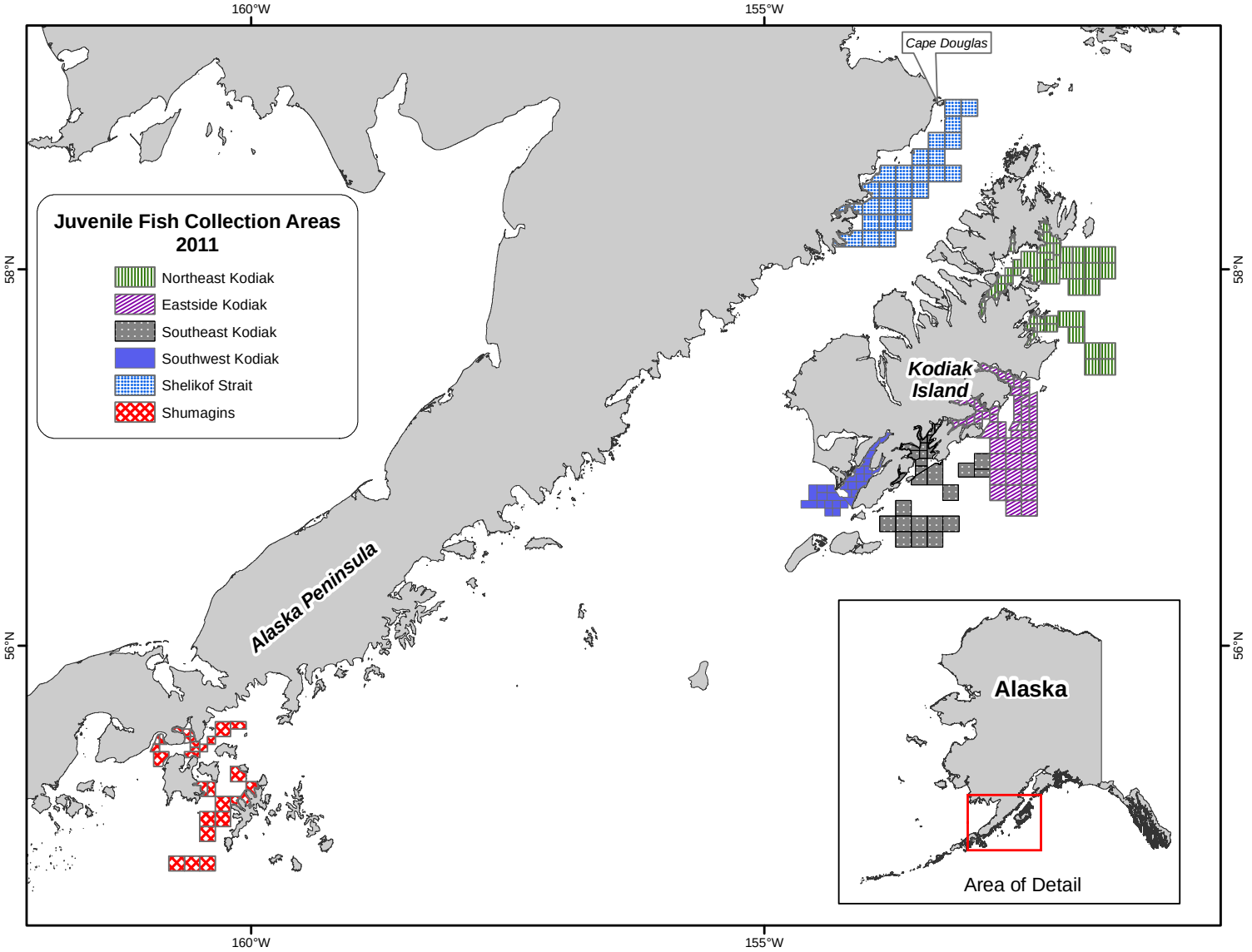
(8) When the cruise is over, please double-check that the lids are completely labeled and add a luggage tag to the bucket handle. The luggage tag should indicate '2010, Marmot Bay, pollock (species), Resolution (boat), and your name'.

(9) Collect at least 20 stomachs per haul, and you can reach the goal.

End of the Cruise:

At the end of the cruise, the buckets (along with the specimen forms) and the remaining equipment should be taken off the vessel and delivered to NMFS, Kodiak Laboratory in Kodiak. Please inform Mei-Sun Yang or Geoff Lang and they will make arrangements to ship them to Seattle.

APPENDIX G. JUVENILE FISH COLLECTION



Appendix G1.–Juvenile fish sampling areas, 2011.

Appendix G2.–Number of juvenile fish, by species and size groups (cm), to be collected in the 2011 survey.

Species	Number	Species	Number
Walleye pollock		**Arrowtooth flounder**	
30-130 mm	100	20-160 mm	100
131-300	100	161-300	100
subtotal	**200**	**subtotal**	**200**
Sablefish		**Rockfish (All)**	
100-200 mm	100	40-130 mm	100
201-350	100	131-300	100
subtotal	**200**	**subtotal**	**200**
Pacific cod			
40-120 mm	100		
121-350	100		
subtotal	**200**		
Total	**1,000**		

PROJECT OVERVIEW

Project Title: Surviving the Gauntlet: A comparative study of the pelagic, demersal, and spatial linkages that determine groundfish recruitment and diversity in the Gulf of Alaska ecosystem

Principle Investigator (PI)/Point of Contact: Jamal Moss

Division: Auke Bay Laboratories

Email: jamal.moss@noaa.gov

Phone: (907)-789-6609

General Description: The overall goal of our proposed research focuses on identifying and quantifying the major ecosystem processes that regulate recruitment strength of key groundfish species in the Gulf of Alaska (GOA). We concentrate on a functional group of five predatory fish species that are commercially important and account for most of the predatory fish biomass in the GOA. Taken together they encompass a range of life history strategies and geographic distributions that provide contrast to explore regional ecosystem processes. We focus on recruitment success because large swings in the abundance of these species have occurred despite precautionary fishing levels. Their early life begins with an offshore pelagic phase followed by a nearshore settlement phase. Spatial distribution, food preference, and habitat suitability of these two life history phases are poorly known. Fieldwork will define a critical environmental window for these five focal species by examining the gauntlet they endure while crossing from offshore spawning to nearshore settlement areas. We will contrast two regions: the central GOA with a broad shelf dominated by high oceanographic variability and large demersal fish biomass and the eastern GOA with a narrower shelf, lower demersal biomass, and higher species diversity. Retrospective data analysis combined with environmental covariates and multispecies stock assessment models will determine the relative influence of environmental parameters and identify processes influencing recruitment. Regional differences will be linked to dietary preference of top level predators to infer causal mechanisms for population trends and influence of climate change on ecosystem structure and diversity.

Detailed collection procedures: Our samples can be collected as part of the routine bottom trawl sampling plan at the pre-determined stations. Collect up to 20 specimens of the following age-0 and age-1 marine fish species at each survey station in the central GOA that they are encountered: Walleye pollock (30-130mm = age-0; 131- 300mm = age-1), sablefish (100-200 = age-0; 200 - 350mm = age-1), Pacific cod (40-120mm = age-0; 121- 350mm = age-1), arrowtooth flounder (20-160mm = age-0; 161-300mm = age-1), and rockfish (40-130mm =age-0; 131-300mm = age-1). Randomly select 10 of each species and age class (10 age-0, 10 age-1) (per haul), up to a total of 200 specimens of a particular species for the region for a grand total of 1,000 individuals for all 5 species. Specimens are to be sealed in a Ziploc bag according to species and frozen immediately. Each Ziploc bag should be labeled with the haul number, survey vessel name, date, and species name with a permanent marker.

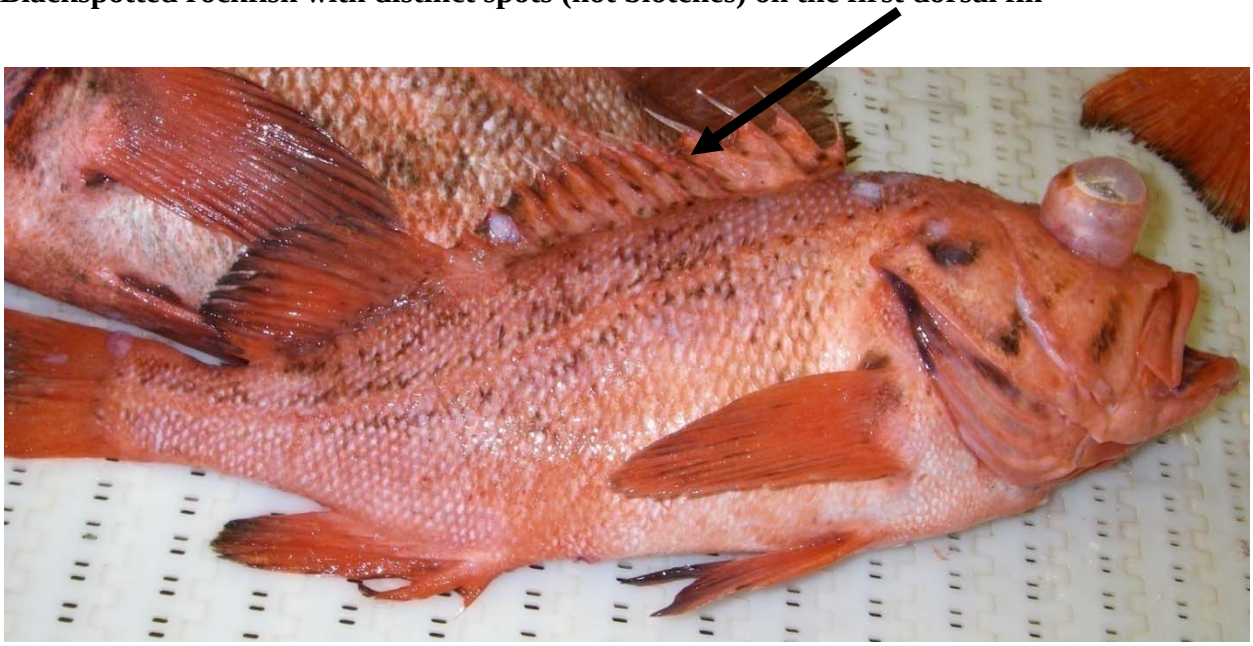
APPENDIX H. DISTINGUISHING CHARACTERISTICS BETWEEN ROUGHEYE AND BLACKSPOTTED ROCKFISH

Appendix H1.–Distinguishing characteristics between rougheye and blackspotted rockfish.

Rougheye and Blackspotted Rockfish

The recent separation of the rougheye rockfish into two species (rougheye and blackspotted rockfish) necessitates the re-examination of the life history of these species (Orr and Hawkins 2008). *Sebastes melanostictus*, the blackspotted rockfish, is distinguished from *S. aleutianus*, the rougheye rockfish, by the presence of spotting on the spinous dorsal fin and a darker color morph and in general is thought to have a more offshore distribution.

Blackspotted rockfish with distinct spots (not blotches) on the first dorsal fin



Rougheye (top) and blackspotted (bottom) rockfish